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# The Impacts of Climate Change on Mountain Leaders in Switzerland and their Adaptation Strategies

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*Je déclare sur l'honneur avoir déposé la version finale de mon manuscrit.*

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*Soli Deo Gloria*

# Table of Contents

# Table of Figures

# Abstract

This thesis investigates the specific impacts of climate change on the profession of mountain leaders in the Swiss Alps and the adaptation strategies they adopt in response. Through a mixed-methods approach combining survey responses from 104 mountain leaders and eight semi-structured interviews, the study reveals a broad range of climate-related challenges affecting the profession.

Mountain leaders report noticeable increases in temperatures, more frequent and intense extreme weather events, and significant changes in seasonality, particularly a reduction in reliable snow cover. In addition, leaders have observed ecological transformations, such as shifts in flora and fauna patterns, as well as increased geohazards like rockfalls, floods, and landslides that can render paths impassable or dangerous.

In response to these changes, mountain leaders are developing a suite of adaptation strategies. These include increased planning and flexibility, spatial and temporal substitutions, diversification of activities, and increasing safety measures. Many leaders also integrate climate change awareness into their interpretive role, using their position to communicate observed changes to the public. While most adaptation remains informal and individually driven, some structural responses, such as integrating these topics into training, are beginning to emerge.

This research fills a significant gap in the existing literature by documenting, for the first time, how Swiss mountain leaders experience and adapt to climate change. It highlights the need for further training and a supportive framework for this growing profession.

# 1 Introduction

Climate change and its effects on the mountain environment are increasingly discussed both in the public sphere and within scientific research. Mountain regions, such as the Swiss Alps and the Jura, are particularly sensitive to these changes due to phenomena like elevation-dependent warming and altered precipitation patterns, as will be developed in more detail in the literature review. These transformations not only affect the physical environment, but also have a direct impact on the people who live and work in mountain environments. Nature-based tourism is especially vulnerable to such environmental changes. Among the professions vulnerable to these shifts are mountain leaders (accompagnateur/trice en montagne), who organize and lead hiking tours in mid-mountain areas. Since their work is intrinsically linked to the state of the mountain environment, both in terms of safety and client experience, the central questions guiding this research aim to understand the environmental impacts perceived by mountain leaders as linked to climate change and how these impact their profession. Following from this, the study investigates if and how mountain leaders are attempting to adapt to these changes and what strategies they adopt.

To properly explore this question, it was essential to understand the broader professional context in which mountain leaders operate. A literature review was therefore conducted to assess the current state of research on climate change and nature-based tourism professions within the study area of Switzerland or in similar environments. Given the considerable lack of literature on mountain leaders, the review was broadened to other nature-based tourism professions in the mountains. Mountain guides were chosen because they represent a parallel yet distinct profession. A detailed description of the mountain leader profession will be given in the literature review, but at this point it is important to understand the distinction between mountain guides and mountain leaders. While both professions involve accompanying clients in alpine environments, they differ in the nature of terrain, techniques employed, and clientele served. Mountain leaders operate in mid-altitude environments and are restricted to non-technical terrain, typically guiding walking or snowshoeing tours without the use of specialized equipment. Their responsibilities extend beyond safety and navigation to include a more interpretative role within the mountain landscape. In contrast, mountain guides are licensed to lead clients in high mountain areas and utilize technical climbing or glacier travel equipment such as ropes, harnesses, and crampons. Despite these differences, the challenges and responses of mountain guides to climate change offer valuable insights that may be applicable to mountain leaders. The second profession investigated is that of hut wardens. Mountain huts were selected as they are also closely linked to on-foot tourism in (mid-) mountain environments. Other sectors, such as the ski industry, were not investigated in the

literature review primarily because they rely on different infrastructures and economic models than do the typically small-scale practices of mountain leaders, mountain guides and hut wardens.

This research is grounded in a mixed-methods approach, combining quantitative data gathered from surveys with qualitative insights drawn both from the survey and from semi-structured interviews. Together, these methods help paint a detailed picture of the challenges mountain leaders face, the perceptions they hold, and the strategies they adopt. This thesis is structured by beginnning with a review of the literature on climate change impacts in mountain regions and on nature-based professions, before presenting the methodology in detail. The results are organized around two main themes – climate change impacts and professional adaptation – followed by a discussion that connects these findings with broader theoretical and applied concerns, such as insights for the future of the mountain leader profession and suggests potential pathways for further research and professional development.

# 2 Literature Review

## 2.1 Climate Change in Mountain Regions

As sentinels of climate change, mountain ecosystems are particularly sensitive to environmental changes (Palazzi et al., 2019). Climate change has had pronounced impacts on mountain regions, with observed warming trends being more intense and rapid than in many other parts of the world (Palazzi et al., 2019). This phenomenon, also known as elevation-dependent warming (EDW), shows that warming rates amplify with elevation, leading to significant changes in the cryosphere and ecosystems (Palazzi et al., 2019). The main overall trends are increased temperature and variations in precipitation (IPCC, 2023).

### 2.1.1 Increased Temperature and Elevation-Dependent Warming

Though no consistent EDW profile was identified at a global scale by Pepin et al. (2022), the concept remains widely accepted, having been demonstrated by multiple paired studies[1]. The mechanisms behind EDW are extremely complex, but it is recognized that factors such as snow-albedo feedback, changes in cloud cover, and increased solar radiation play significant roles (Palazzi et al., 2019; Pepin et al., 2022)

In the Swiss Alps, temperature increases have been particularly significant. Studies indicate that air temperatures have risen twice as fast as the average for the Northern Hemisphere over the past century, as seen in figure 1 (Klein, 2018; Rebetez & Reinhard, 2008). The National Centre for Climate Services (NCCS) projects that, if greenhouse gas emissions continue, the annual average temperature in the Alps could rise between 2-4°C by mid-century, depending on the emission scenario (RCP 2.6 or 8.5) (NCCS, 2018). This rapid warming will continue to impact precipitation, snow cover, increase glacial retreat, and generally alter the mountain ecosystems.

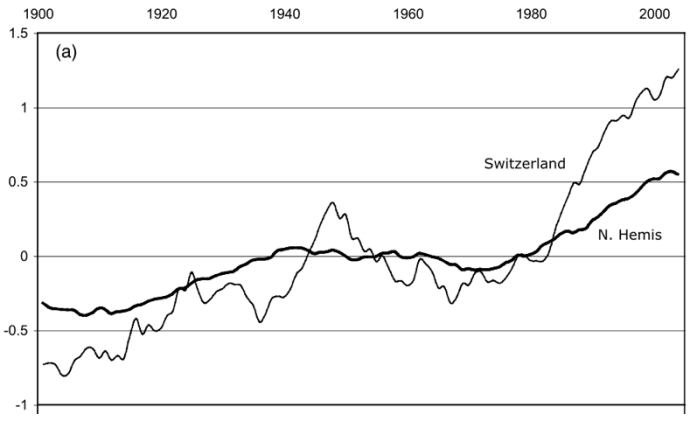


*Figure 1: Annual temperature anomalies [° C] in Switzerland compared to the Northern Hemisphere 1901–2004 (Rebetez & Reinhard, 2008)*

[1] See the bibliography of 'Elevation-dependent warming in mountain regions of the world' (Mountain Research Initiative EDW Working Group, 2015) for a full list of paired studies on EDW.

### 2.1.2 Seasonal Shifts and Changes in Precipitation Patterns

Changes in precipitation patterns are less consistent than temperature changes, with significant seasonal and regional variability. Generally, however, mountain regions are expected to experience changing weather patterns, with precipitation changing in time and extent. (IPCC, 2022).

In the Swiss Alps, future climate scenarios predict an increase in winter precipitation and a decrease in summer precipitation, along with heavy rainfall events in all seasons (Kotlarski et al., 2023; NCCS, 2018; Scherrer et al., 2016). With increased air temperatures, the fraction of precipitation that falls as rain rather than snow will continue to rise (Klein, 2018; Kotlarski et al., 2023).

### 2.1.3 Consequences on Snow Cover and Glaciers

A concatenation of increased temperature and changes in precipitation has a marked impact on glaciers and snowpack in the mountains. Climate change has led to widespread reductions in snow cover extent and duration, as well as accelerated glacier retreat (IPCC, 2022).

In the Swiss Alps, snow cover is expected to decrease significantly at all but the highest elevations (Klein, 2018), meaning that low to mid-altitude areas are particularly affected. The reduction in snowfall fraction and an increase in rainfall will contribute to overall declines in snow accumulation, though the increase in winter precipitation 'might partially offset this temperature effect and lead to higher snowfall sums compared to a non-modified precipitation regime' (Kotlarski et al., 2023, p.77). Figure 2 shows how days with fresh snow are forecast to decrease over the next decades, with mid-altitude ranges being particularly touched. Glaciers in the Alps are retreating rapidly, with predictions indicating substantial reductions in glacier mass by the end of the century (Kotlarski et al., 2023; NCCS, 2018).

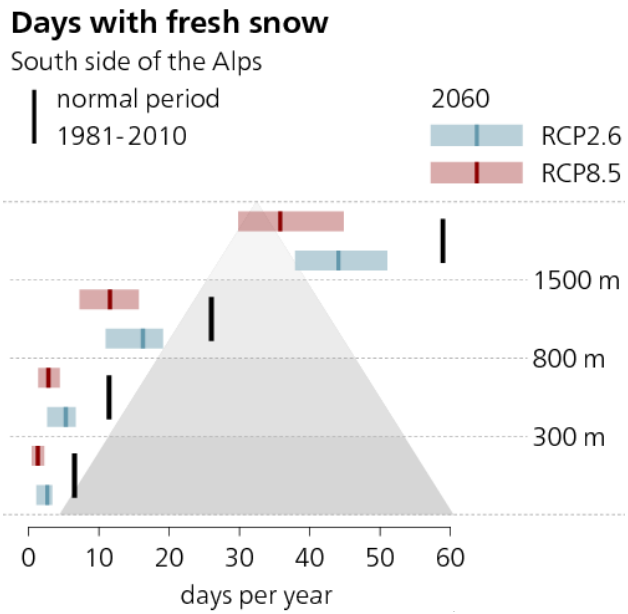


*Figure 4: Days with fresh snow depending on elevation in the Swiss Alps (© climate scenarios CH2018, NCCS, 2018)*

### 2.1.4 Ecological Changes

The environmental changes in mountain regions linked to climate change affect not only the weather patterns, but also ecological systems and human activities. Changes in snowmelt timing, growing seasons, and vegetation patterns have significant ecological consequences, while altered hydrology and increased hazards like landslides and floods impact human populations and economic activities (IPCC, 2023). In the Swiss Alps, earlier snowmelt has been linked to changes in plant growth cycles, allowing for a longer growing season and increased plant height (Klein, 2018).

In summary, the main environmental changes in the study area are rising temperatures and changes in precipitation regimes, which lead to loss of snowpack and glaciers, which in turn causes repercussions on the mountain vegetation.

## 2.2 Impacted Professions in Nature Based Tourism

By affecting nature in mountain environments, climate change also impacts those who live in and rely on these environments, for example mountain communities, professionals such as guides and mountain leaders, mountain huts and winter sports resorts. These lie under the umbrella of nature based tourism (NBT), which has been growing in popularity since the late 18$^{th}$ century, and is a source of income for mountain communities and professionals the world over (Rushton & Rutty, 2023). NBT however, is heavily reliant on environmental conditions. This can leave communities and professionals vulnerable to even the slightest change in climate (Dube & Nhamo, 2020; Rushton & Rutty, 2023). This study will focus on specific professions that are impacted by climate change, such as mountain guides, mountain hut keepers, and mountain leaders, as well as their specific adaptation strategies.

The literature reviewed for this research focuses on studies from the study area of Switzerland, as well as including studies from similar environments such as the French and Italian Alps and the Candian Rockies. Although the latter regions are not directly within the scope of this study, insights from these areas are highly relevant. The environmental and social conditions in both are similar to those in the Swiss Alps, allowing for the assumption that impacts and adaptation strategies might be comparable. Furthermore, several studies are transboundary, covering regions in Switzerland, France, and sometimes Italy, providing a broader perspective on the subject matter.

### 2.2.1 Mountain Leaders

The term mountain leader will be used throughout this study, but the technical term for Swiss mountain leaders is 'accompagnateur en montagne' in French. This section looks at the history of the mountain leader profession, the training and role of a mountain leader (and how this differs amongst the study areas), as well as where the profession stands in the world of scientific research.

#### 2.2.1.1 Emergence of the Mountain Leader Profession

In Europe, mountain and nature-based tourism started to develop in the first half of the 19th Century. Alongside the growing access to the mountains came an increased interest in exploring them. With this development came a need for guides to lead groups in the mountains. Training programs and certification were developed in Switzerland, in the second half of the 19th Century (Clivaz & Langenbach, 2020).

The end of the 20th Century saw an emergence of a similar yet different profession to mountain guides – mountain leaders. In some senses they are similar, in that both accompany individuals or groups in mountainous regions, 'they are differentiated, however, by their clientele, the different types of terrain that are used and the techniques employed to advance in these terrains' (Clivaz & Langenbach, 2020, p.3). The sections below explain in more detail the profession in Switzerland its specificities. Overall however, Mountain Leading is primarily a walking award (Cousquer & Beames, 2013), where the mountain leader takes clients in mid mountain ranges, that don't require technical equipment, and is responsible for managing the itinerary and safety of the group (Accompagnateur-trice en montagne, n.d.; Overview of ACMG TAP, n.d.; Beedie, 2003; Clivaz & Langenbach, 2020).

#### 2.2.1.2 Swiss Accompagnateurs en Montagne

In Switzerland, accompagnateurs en montagne are qualified with a federal brevet. The first type of certification was recognised in Valais in the 1990s, but only recognized on a federal level as of 2011 (Clivaz & Langenbach, 2020). The training followed spans a minimum of 3 years, and is given by different providers, including the Swiss Association of Mountain Guides (ASGM). It occurs over both summer and winter seasons, and includes different modules, such as first aid, nature (fauna, flora, geology, etc.), culture, weather, communication, and business management.

The accompagnateur's role is to organize hikes in the mid mountain range, on foot, or using snowshoes. Their clients are typically individuals, or families, companies, school groups, etc. (Accompagnateur-trice en montagne, n.d.). Accompagnateurs en montagne may not use technical equipment such as ropes and ice axes in a planned manner (they may carry personal equipment in case of emergencies), and must therefore plan their routes accordingly. One of their main focuses is on an enriching experience for the clients, where they can learn more about the surrounding mountain environment in a pedagogical manner (Figure 3). During the hikes, the accompagnateur should share their knowledge of the nature and culture of the area, enlightening their clients on the local flora and fauna, geology, economy, history, etc. (Clivaz & Langenbach, 2020). In this sense, Swiss mountain leaders can claim the same as British International Mountain Leaders, that 'they are specialists in both interpreting the mountain environment and leading groups safely through it.' (Cousquer & Beames, 2013, p.209).

*Figure 3: The interpretative role of mountain leaders (© UNESCO Swiss Alps Jungfrau Aletsch)*

#### 2.2.1.3 Mountain Leaders in the World of Scientific Research

A few studies have made the mountain leader profession the object of their investigation, such as Clivaz and Langenbach's 2020 paper on the organization and professional development of mountain leaders in Switzerland and France. Bourdeau's 2014 research report on climate change impacts on alpinism in the Écrins does take information from mountain leaders, however they are never targeted specifically or uniquely. Carlson's 2021 study on French guides' adaptation to climate change also mentions mountain leaders, but similar to Bourdeau, does so alongside guides, and the content is usually more relevant to mountain guides, as it is focused on the high mountain environment. A study in Canada (Henning, 2008) uses a hermeneutical theatrical model to analyze a guided hike in Banff National Park. Part of Henning's research looked at how the hiking guide interpreted the landscape, and how this contributes to the clients' knowledge and comprehension of sustainable development. Another paper, written in 2009 by Guyon, analyzes French mountain leaders' websites, to determine on what they base their professional identity, and what the products they offer say about them and their relationship to space and heritage (Guyon, 2009). He details how mountain leaders in France inevitably exploit the natural resources, be it 'natural, geological, architectural, alimentary, technical or cultural' (Guyon, 2009, p.62, own translation). They are also important players in regional development, by contributing

to local tourism and society, and by transferring vernacular knowledge (Guyon, 2009). Finally, Bonnemaison et al.'s paper explores the complex gender dynamics within the mountain leader profession in France, and how entry and work practices differ between the genders (Bonnemaison et al., 2019).

In light of the above, we can see that mountain leaders are present in scientific literature, but in a minimal way. I was not able to find any scientific papers that address mountain leaders in Switzerland specifically. A few unique papers address aspects of the profession in the Alps (mostly France), but on the whole, it is very sparsely documented. In addition, there are, as yet, no scientific papers that specifically target mountain leaders' relationship to climate change, either in how they are impacted, the potential opportunities it might bring, or their adaptation strategies. This is the research gap that this paper hopes to shed light on.

### 2.2.2 Mountain Guides

Climate change in the Alps is causing a deterioration in conditions for summer mountaineering, which is only increasing with time (Mourey et al., 2020). This is due to different effects of climate change on the landscape, such as 'detrimental geomorphological processes' (Mourey et al., 2020, p.2), which may in turn increase both difficulty and risk. On a large scale, high mountain areas are seeing changes in seasonality, and on a smaller scale there is a decreased predictability of conditions (figure 4). We will look at each of these dimensions in turn, to gain an overview of how mountain guides are impacted by climate change.

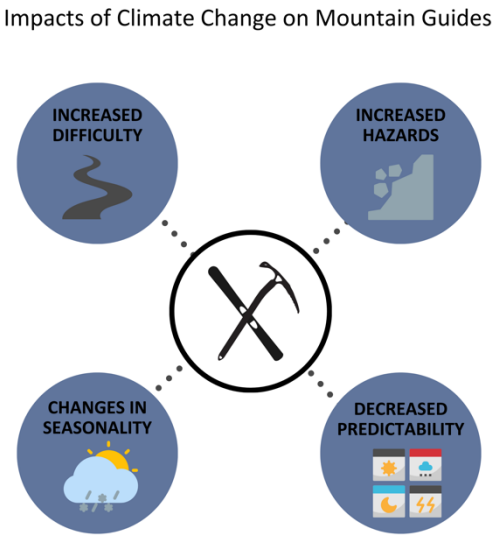


*Figure 4: Impacts of climate change on mountain guides (© Hannah Pillon, inspired by Miczka, 2022)*

Firstly, according to different studies, mountain guides in different regions of the Alps are noting **increased difficulty** of some itineraries, sometimes even leading to itinerary abandonment (Bourdeau, 2014; Carlson et al., 2021; Mourey et al., 2020; Salim et al., 2019). This can take various forms but is often related to glacier ice loss. This can cause increased slope degree (Bourdeau, 2014; Mourey et al., 2019), the appearance of crevasses, or the need to add climbing pitches (Salim et al., 2019). The disappearance of snow and ice cover has also been observed, thus making routes unclimbable in summer (Mourey et al., 2019). 'Slopes that used to be snow-covered and relatively easy to use crampons on are increasingly 'icy' and are getting steeper' (Carlson et al., 2021, p.31). All of these environmental

changes lead to increased technical difficulty and the need to find adaptational strategies (Bourdeau, 2014; Mourey et al., 2020; Salim et al., 2019).

Other effects of warming are decreased snow bridge thickness, increased risk of rockfall (Jacquemart et al., 2024), or even total disappearance of routes due to massive rock fall, such as in the case of the Petit Dru (Mourey et al., 2019). This **increase of hazards** in the mountains is noted by guides in the Alps, where both serac break-offs and rockfalls cause increased risk and decrease routes' feasibility (Carlson et al., 2021; Mourey et al., 2020). Hanly and McDowell's (2024, p.11) study specifically focuses on physical hazards and the guiding profession in the Canadian Rockies. Based in the Lake Louise area, they show how 'There is a statistically significant ($p<0.05$) correlation between rising temperatures and increases in the frequency of reported objective hazards. This is evident on the Guide's route, where rockfall notably increased from the 1990s onwards, aligning with increases in temperature and snow and ice loss' (Figure 5).

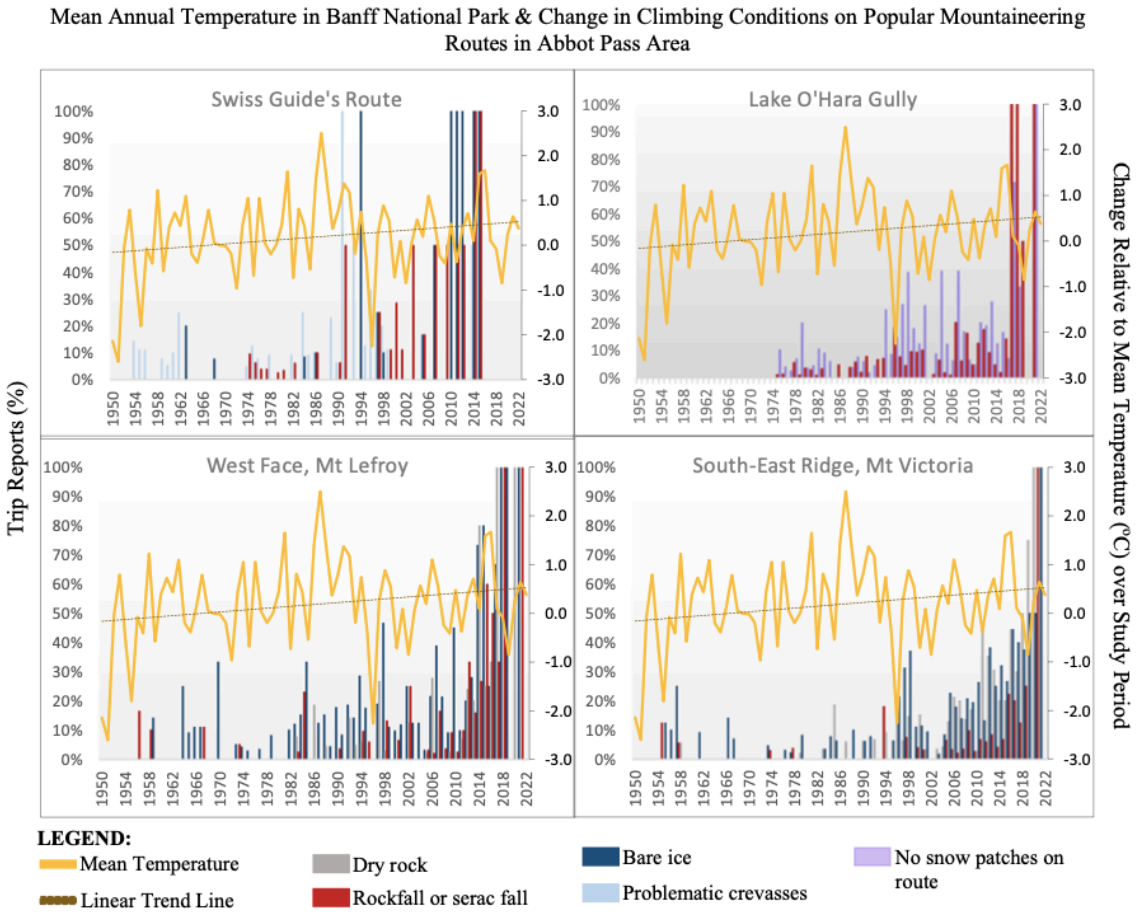


*Figure 5: Percentage of trip reports describing change in climbing conditions and objective hazards in the Abbot Pass area of Lake Louise between 1923 and 2022 and corresponding change in temperature relative to study period average. (Figures start in 1950 as no reports describe change in climbing conditions and objective hazards before that.) (Hanly & McDowell, 2024)*

Secondly, mountain guides, as all alpinists, are faced with **changes in seasonality**. Due to increased temperatures, there is a noted decrease in quality and duration of the snowpack, which now melts earlier on in the season (Carlson et al., 2021; Mourey et al., 2019). Guides in the massif des Écrins as well as the Chamonix area estimate that the summer season has come forward by about four weeks (Bourdeau, 2014; Salim et al., 2019). This means that the months of May and June allow for previously almost non-existent alpine activity to be able to take place. However, this can cause problems for guides, since their clientele is often only available during the summer holiday period, creating a 'seasonal mismatch' (Mourey et al., 2020). Canadian guides also note changes in seasonality, notably 'increase in the length of both the summer and shoulder (spring and autumn) guiding seasons […] and a decrease in the winter guiding season.'(Rushton & Rutty, 2023, p.3908)

Coupled with the changes in seasonality is a **decreased predictability of mountaineering conditions** (Mourey et al., 2020). Opportune windows to do certain routes may only appear sporadically and

unpredictably, for example an ice climb in November (Chevaillot et al., 2006). Carlson et al. (2021) explain that snow conditions will become more random, with decreasing days of powder and increasing spring snow, even in mid-season. The decreased predictability coupled with the changes in season result in 'the progressive reduction in the terrain available for mountaineers as the summer season progresses and good periods are now more likely to occur in spring, fall and even winter on some itineraries.' (Mourey et al., 2019, p.186)

All of these changes strongly impact the mountain guide profession in the Alps and beyond. To continue to practice, mountain guides need to find adaptation strategies to tackle the challenges of climate change.

### 2.2.3 Mountain Huts

One main area of human mountain environments facing the effects of climate change are mountain huts, and those who manage and run them. Mountain huts both in Switzerland (cabane or refuge de montagne) vary from being comfortable, family friendly, easily accessible, and fully catered, to high mountain, emergency refuges with only the basics (Cabanes et courses, 2024). These structures are typically placed along key climbing routes, making it easier to divide longer ascents into manageable segments. They are also stocked with basic necessities such as food, fuel, sleeping facilities, and medical supplies, which helps reduce the logistical burden and pack weight for mountaineers (Hanly & McDowell, 2024). In Switzerland, mountain huts are managed by the Swiss Alpine Club or by private owners.

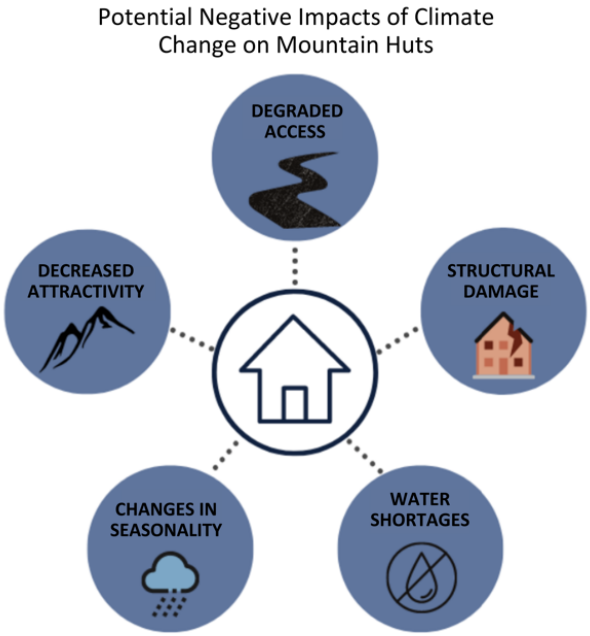


*Figure 6: Potential negative impacts of climate change on mountain huts (adapted from Miczka, 2022)*

In his thesis, Miczka (2022) summarizes the main potential negative impacts of climate change on mountain huts in the Alps (Figure 6). He found that the main impacts of climate change on mountain huts include degraded access paths, structural damage to buildings, water shortages, changes in seasonality, and a decline in attractiveness.

The first negative impact to huts is that of **access path degradation**. Due to glacier melt, itineraries in the mountains, including hut access paths, can be altered and can increase in difficulty, from slightly to severely (Bordeau, 2014, p.8). A study in the Chamonix area shows how loss of glacier ice thickness of the Mer de Glace directly affects access to the surrounding five huts. This requires the installation and then maintenance of infrastructure such as ladders to access places where previously the glacier would have facilitated access, as seen in Figure 7 (Mourey & Ravanel, 2017). But installing equipment raises questions regarding sustainability, both in financial and ethical terms, putting future access of huts into question (Carlson et al., 2021). This also strongly impacts mountain guides, as we will see later. Permafrost degradation can also influence the stability or safety of specific routes (Rushton & Rutty, 2023). Decreasing the access or the safety of access to huts will logically have an impact on hut frequentation.

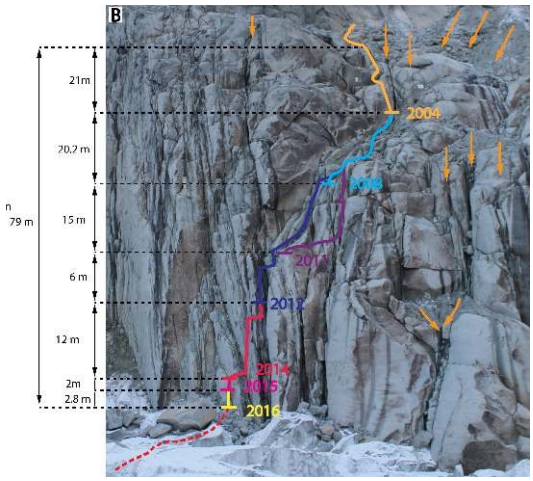


*Figure 7: Successive additions of ladders to enable access to huts in the Mer de Glace area, FR (Mourey & Ravanel, 2017).*

The same forces that endanger paths can also cause damage to the mountain huts themselves. There are a few cases of permafrost degradation causing **structural damage** in the Alps. The Mutthornhütte (Figure 8), for example, was permanently shut in 2021. The retreat of the Kanderfirn glacier has destabilized the rock island on which the hut is built. In addition, there is now a landslide risk that threatens both access to the hut and the hut itself (Coulin, 2020; Miczka, 2022). By nature, these first two effects mostly concern high altitude huts, which are in glacier and permafrost terrain. Lower lying huts are less prone to be affected by glacier or permafrost melt, and therefore access and structural stability are more likely to be preserved.

*Figure 8: Mutthornhütte, permanently closed in 2021 due to rockfall danger (© Petroni, 2021)*

The third potential negative impact of climate change is **hydraulic shortages**. Many huts face this challenge to a greater or lesser degree, but this can be an important stressor (Kuenzi, 2012). Different

huts have different water sources: sources, torrents, lakes, glaciers, and can sometimes, though rarely, be attached to a drinking water network (Vuilleumier, 2014). Some huts' only source is melt water, but névés are melting earlier and earlier in the summer season and glacial retreat also impacts water supply. Hotter and drier summers mean that the water sources are drying up far earlier in the season. Many huts in Switzerland face water shortages, the Dix, Chanrion, and Konkordia huts being just a few examples among many (Miczka, 2022; Rausis, 2022; Swiss Alpine Club, 2022b).

A fourth impact of climate change which requires adaptation are **changes in seasonality**, notably with the summer season coming forward. The changes are similar to those faced by mountain guides, as elaborated in section 2.2.2, as they affect all mountaineering activities (Carlson et al., 2021; Mourey et al., 2019; Salim et al., 2019).

Finally, some huts in the Alps are seeing a **decrease in attractiveness** due to how glacier melt alters the aesthetic of the landscape. Though the specific link between hut frequentation and decreased attractiveness has not yet been specifically studied, it can be supposed with a fair level of confidence, as these huts no longer correspond well to the classic vision of what the high alpine territories 'should look like' (Diolaiuti & Smiraglia, 2010; Garavaglia et al., 2012; Moreau, 2010; Salim et al., 2019).

## 2.3 Adaptations to Climate Change

### 2.3.1 Dimensions of Adaptation

Adaptations to climate change can be defined as 'changes in social-ecological systems in response to actual and expected impacts of climate change in the context of interacting non climatic changes. Adaptation strategies and actions can range from short-term coping to longer-term, deeper transformations, aim to meet more than climate change goals alone, and may or may not succeed in moderating harm or exploiting beneficial opportunities.' (Moser & Ekstrom, 2010, p.22026). This definition builds on those of the IPCC (IPCC, 2007) and of Smit et al. (2000), who offer supplementary dimensions to the term adaptation.

The **aim** of adaptations is to alleviate any negative impacts of climate change, while harnessing opportunities if they present themselves (Smit et al., 2000). It is interesting to point out that Moser & Ektrsom's definition, in contrast to that of the IPCC, does not presume a positive outcome of the adaptation strategies, though it remains the intent (Moser & Ekstrom, 2010).

There is a **temporal dimension** to adaptation, depending on when the changes happen, and for how long they are intended to be implemented. Moser & Ekstrom's definition (2010) adds to the IPCC definition that adaptation strategies may be different depending on envisaged implementation duration

and effect. In this sense, adaptations differ depending on whether they are intended to be for the short or the long term. The other temporal dimension of adaptations is the timing at which they occur: adaptations can be 'reactive' or 'anticipatory' (Smit et al., 2000). Reactive adaptations happen in response to climatic stimuli, whereas anticipatory strategies are put in place in the context of an expected change or event (McDowell, 2020).

Adaptations also differ in levels of **spontaneity** and **formality**, and can be classified as **'autonomous' or 'planned'** (McDowell, 2020; Smit et al., 2000, p.224). Autonomous adaptations are less formal, occurring naturally (Smit et al., 2000). Often, they occur at the individual or community level, being 'devised without external support' (McDowell, 2020, p.45). Planned adaptations, on the other hand, usually have a higher degree of formality and strategy, and may involve 'deliberate policy development' (McDowell, 2020, p.45, Smit et al., 2000).

Finally, adaptations can differ in **form**. They can take 'technological, economic, legal and institutional forms' (Smit et al., 2000). As concrete examples, technological adaptations might include developing new technologies or techniques to counter certain impacts. Economic adaptations might involve changing economic sectors, making investments, or developing insurance schemes. Changes in law and policy can insure and enable certain legal adaptations, and adjustments to organizations and practices can be encompassed by institutional adaptations.

#### 2.3.1.1 Adaptive Capacity

The adaptive capacity of a community or individual denotes the ability that they have to adapt. At community level, this is determined by a variety of possible social factors, such as education, financial situation and social safety nets, political influence, as well as access to various resources and infrastructure (McDowell, 2020; Smit and Wandel 2006).

At the individual level, adaptive capacity consists of their 'efficiency in implementing mechanisms and strategies to survive in the face of a threat' (Salim et al, 2019). If, within their field of work, nature-based professionals are affected by climate change, they are likely to need to adapt to some extent or other. The tourism sector is generally considered to have a strong adaptive capacity (Scott et al., 2009), however this varies from one group to another, thus remaining context specific (Salim et al, 2019; Smit and Wandel, 2006). Even within a group, adaptive capacity can vary between individuals (Mourey et al., 2020), depending on their individual situation, knowledge and resources.

### 2.3.2 Adaptation of Mountain Guides

Most of the studies researching the adaptation strategies of mountain guides have been conducted outside of the study zone, either in the French or Italian Alps or in the Canadian Rockies. However, they can still offer valuable insights given similar environments. In this sense, understanding climate change, its impacts, and how best to react is an essential key to ensuring the sustainability of the mountain guide profession in general (Carlson et al., 2021). Research on the adaptation of mountain guides is highly relevant to this study given the similarity of the professions, and will therefore be given detailed attention. The findings in this field may help as a basis for understanding similar impacts and adaptation strategies that mountain leaders do or could adopt.

Carlson et al. chose to split the adaptations into short and long-term adaptation strategies (2021), as shown in Figure 9. Guides need to implement both: 'Short-term, reactive strategies to adapt in the short term to sudden changes, and long-term, proactive strategies to anticipate the profound changes needed in the profession.' (Carlson et al., 2021, p,46-47, own translation) The short-term adaptations tend to be more reactive and autonomous, whereas long-term adaptations are more formal and planned. Each section will look at the strategies that are common between the two study areas, as well as the strategies that are unique to one or the other.

Any adaptation, however, requires innovation and creativity (Bourdeau, 2014). There is a need for new ideas that respond to a specific need in a helpful way.

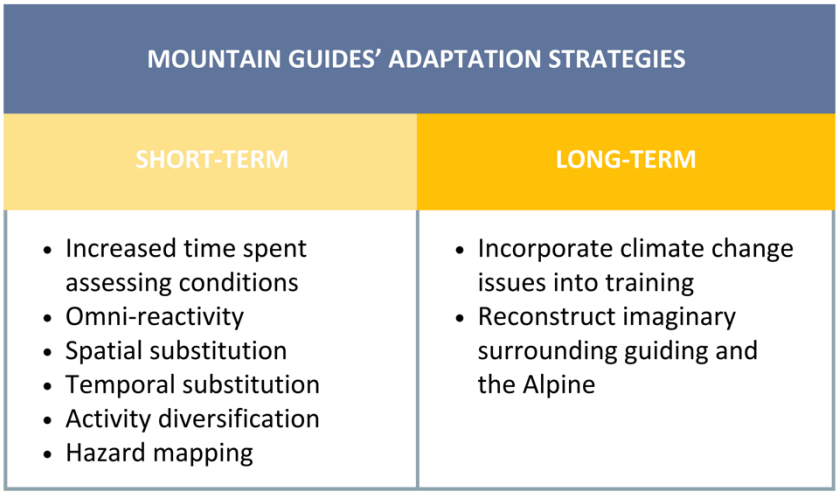


*Figure 9: Mountain guides' adaptation strategies to climate change impacts (© Hannah Pillon, inspired by Carlson et al, 2021)*

#### 2.3.2.1 Short-Term Adaptation Strategies

These strategies are put in place by individuals to face a current need. They are put in place relatively naturally, in order to respond to active climate stimuli. Strategies that are common in the Alps include activity diversification, temporal and spatial changes, as well as an increased responsiveness to conditions. We will look at each of these strategies in turn.

##### 2.3.2.1.1 Assessment of and Reactivity to Conditions

One of the first and most basic adjustments that mountain guides have to make to climate change is **increasing the time spent assessing the conditions**, and being able to react accordingly (Mourey et al., 2020). This means spending a considerable amount of time looking at different weather forecasts, as well as using social networks to help with recent route conditions. In this sense, the development of digital technologies provides guides with useful tools to share conditions, such as professional mailing lists, social media groups, or specialized websites (La Chamoniarde, CamptoCamp, Skitour, etc.) (Mourey et al., 2020). Thanks to these technologies, guides and mountaineers can share what conditions were like on a specific route, which can give valuable information for guides' decision making.

With this information though, guides also need to be able to be **reactive to open weather windows.** Guides are required to have an almost 'permanent availability to climatic, snow and weather conditions' (Bordeau, 2014, p.6, translation own). This requires regular reorganization, as guides and clients need to be available to make the most of these short and unpredictable windows of good conditions (Mourey et al., 2020), which Salim et al. coin as '**omni-reactivity'** (Salim et al., 2019, p.6).

What guides then do with this information can often lead to either temporal or spatial substitutions – that is, they either make changes to where they were planning on going, or when they were planning to go.

##### 2.3.2.1.2 Spatial Substitutions

**Spatial substitutions** can mean anything from choosing a different route to the same objective, changing the objective within the same area, or changing mountain range all together. Guides in Chamonix and Courmayeur said that if conditions are bad, they would tend to alter the type of route chosen, by choosing a rockier, more predictable route to ascend the Tour Ronde, for example (Salim et al., 2019). Alternatively, if local conditions are still not good enough, guides might also take their clients to other mountain ranges (Grand Paradiso, Écrins, Valais), with the aim of finding better conditions elsewhere (Salim et al., 2019). Thanks to increased mobility, guides in the Mont Blanc area are able to avoid routes that are in bad condition, and go to where conditions are more favorable (Mourey et al., 2020). Similar trends are seen in the Canadian Rockies, where certain routes become impracticable,

favouring ascensions by other routes (Hanly & McDowell, 2024), or exploring new areas to find new routes so as to 'create a more suitable and safer guiding environment' (Rushton & Rutty, 2023, p.3911). This adaptation strategy is what Salim et al. (2019) call 'omni-mobility'.

#### 2.3.2.1.3 Temporal Substitutions

Another adaptation strategy observed in the Alps and elsewhere is that of **temporal substitution** (Bourdeau, 2014; Hanly & McDowell, 2024; Mourey et al., 2020; Salim et al., 2019), and can happen at a seasonal or daily level (Rushton & Rutty, 2023). In order to adapt to unpredictable or unfavorable conditions, notably in summer, guides adapt by shifting the seasonality of their activity. They look to guide more in the spring, early and late summer, when routes are in better condition (Carlson et al., 2021; Hanly & McDowell, 2024; Mourey et al., 2020).

#### 2.3.2.1.4 Activity Diversification

Finally, since the other strategies are not always sufficient or require too much uncertainty, guides are increasingly moving towards **activity diversification** (Bourdeau, 2014; Carlson et al., 2021; Mourey et al., 2019; Rushton & Rutty, 2023; Salim et al., 2019). Mountain guides in the Mont Blanc area say that they are 'supervising more and more activities that are not practiced in high mountains such as climbing schools, mountain biking, trail or via ferrata' (Salim et al., 2019, p.6). These activities, which are less dangerous than high mountain alpinism (Mourey et al., 2020), as well as less dependent on convergence of specific weather and environment conditions, are increasingly becoming alternatives to alpinism (Bordeau, 2014). They are therefore more predictable and don't require so much constant flexibility in both time and space. On a similar vein, some guides are relying less on time spent in the high mountains, and 'can also develop - in a traditional or unprecedented way - a system of complementary activities in a multi-active framework, within or outside the perimeter of the tourist economy' (Bordeau, 2014).

#### 2.3.2.1.5 Hazard mapping

An additional proactive adaptation strategy, currently only observed in Canada, is the use of **hazard mapping** (Rushton & Rutty, 2023). These maps depict how guiding routes have been impacted by natural hazard risk, such as wildfires or floods, and the associated risks. Other similar plans outline safe as well as evacuation zones near classic guiding routes. An examination of existing literature does not yet show that hazard mapping is a tool used by guides in Switzerland or the Alps in general.

### 2.3.2.2 Long-Term Adaptation Strategies

While the strategies developed above may answer the immediate problems, there is also a need for longer term, formalized and better planned adaptations. These would hope to tackle anticipated changes, whilst continuing to provide strategies for the present situation.

The main foreseeable long-term strategy is the **incorporation of climate change in the guides' training programs**. Though this has been suggested by multiple authors as a potential highly useful strategy (Bourdeau, 2014; Carlson et al., 2021; Hanly & McDowell, 2024), it is not obvious that any such developments have been put in place to date in any consequential form. Carlson's report mentions that French guides now have an extra week added to their training where they discuss the future of the profession, and can share thoughts about environmental issues. Hanly & McDowell suggest a transdisciplinary collaboration for such training courses, using the specific knowledge of researchers, mountain guides, and professional associations (2023).

Another adjustment which Carlson et al. suggested in the French Alps is a **reconstruction of the imaginary** surrounding guiding, to redefine the guiding experience (2021). The idea being to promote an experience in the mountains, rather than a specific route or summit. The focus would be to spend time in a certain area, and focus on other aspects such as immersion in nature and a pedagogical dimension to the experience, such as learning to be autonomous (Carlson et al., 2021). Carlson et al. encourage highlighting an overlooked value of the profession, which is a shared experience lived in the mountains (Carlson et al., 2021).

An example of such a reimagination is the decentralized alpine guide office 'Immersion Alpine'. Composed of mostly young guides, the collective is united by shared values and a common vision in how they practice their profession. They look to promote environmental sustainability, and promote an experience in the mountains over 'a summit at all cost' (Immersion Alpine, n.d.).

#### 2.3.2.3 Factors For and Against Good Adaptation

Adaptation for mountain guides in Switzerland is influenced by a variety of factors, both facilitating and hindering their ability to respond to changing conditions. One major factor that helps adaptation is the willingness of guides to adopt certain strategies mentioned above, which may significantly alter how they exercise their profession (notably to diversify their activities or change the seasons). On the other hand, guides who are willing to take more risk in the high mountains can adjust in this manner, though it is not directly seen as an adaptation strategy (Mourey et al., 2020). However, guides who continue to practice traditional mountaineering, without trying to diversify their activities, yet who may not want to increase their risk taking, find it difficult to adapt (Mourey et al., 2020).

There are other major factors that hinder adaptation. Organizational issues, such as the need for flexibility in time or space, pose significant challenges. Clients are often free during the summer holiday, which no longer presents optimal conditions for mountaineering. In addition, clients are often emotionally attached to climbing certain routes or summits, which limits guides' ability to make spatial or activity substitutions (Hanly et al., 2023; Mourey et al., 2020).

On the whole, more experienced guides, who have long-standing relationships with their clients find it easier to adapt than younger guides who do not yet have an established clientele, and who often fear turning down specific work (Hanly et al., 2023; Mourey et al., 2020).

Ultimately, the adaptation process is complex and multifaceted, heavily influenced by both internal factors, such as the guide's willingness to take risk and diversify, as well as external factors, such as client expectations and organizational constraints.

### 2.3.3 Mountain Huts

Mountain huts are faced with the impacts of climate change, and need to find adaptation strategies (Figure 10). These need to address issues such as hut access and water management, requiring coordination among players, but adaptation can also offer opportunities such as diversification.

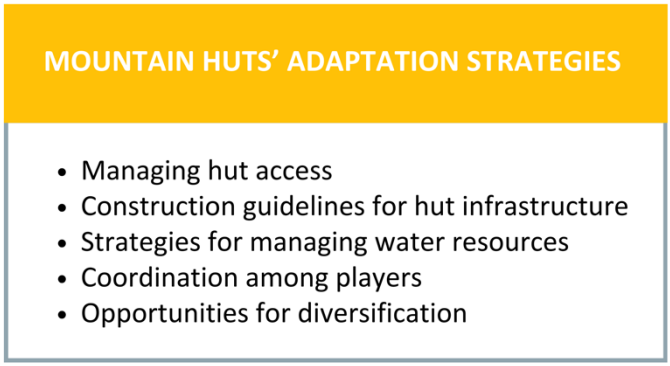


*Figure 10: Mountain huts' adaptation strategies to climate change impacts (© Hannah Pillon)*

#### 2.3.3.1 Managing Hut Access

Managing access to mountain huts in the face of climate change runs parallel to finding sustainable solutions to path dependence. Adding equipment, such as ladders or bridges, to make routes safer or more accessible as conditions change is often a reactive measure (Miczka, 2022). However, this approach has its limits and controversies, as some have always argued that adding equipment conflicts with the ethics of alpinism (Moraldo, 2016), as well as increasing maintenance costs (Coulin, 2020). Additionally, from a sustainability perspective, such reactive adaptations often perpetuate path dependence, where temporary fixes constrain future options. However, it is generally easier and cheaper to add equipment to existing paths rather than devising new, alternative routes, which can hinder rapid adaptation and significantly delay responses (Miczka, 2022).

Nevertheless, there are instances where envisioning and creating new routes can be a proactive and effective strategy, despite the high costs in time and resources. For example, in the Val Bondasca, the existing paths to the Sciora hut were closed indefinitely following the 2017 Bondo landslide. Despite this, a new access path was envisioned, and the hiking trail will be accessible as of July 2025, with the hut scheduled to reopen at the same time (Swiss Alpine Club, 2025). This approach demonstrates that, while costly and time-consuming, planning new routes can in some cases provide an alternative and sustainable solution for managing hut access.

#### 2.3.3.2 Construction Guidelines for Hut Infrastructure

Structural damage is one of the most difficult impacts to adapt to, and mostly requires pre-emptive adaptation (Miczka, 2022). This is addressed in the SAC document that lists guidelines for hut construction (Swiss Alpine Club, 2022a). In this sense, possible future structural damage to the buildings needs to be taken into account before a reconstruction or substantial renovation (Miczka, 2022).

#### 2.3.3.3 Strategies for Managing Water Resources

There are different ways to address the water shortage problem that many huts face, and a combination of methods is usually best. Some huts are investing in new infrastructure to bring in more water. However, this approach is often complicated and costly, requiring constant updates as glaciers continue to retreat and snow melts earlier in the season. As an alternative, many huts are implementing water-saving measures, such as rationing the amount of water guests can use (Miczka, 2022; Rausis, 2022; Swiss Alpine Club, 2022b; Vuilleumier, 2014).

Success, however, depends heavily on guest understanding and compliance to measures put in place by the hut warden. Therefore, it is essential to teach visitors about the importance of being economical in water usage. The planned adaptation of raising awareness can help guests appreciate the challenges and cooperate with the water-saving measures in place, and provide a more sustainable demand (Miczka, 2022; Swiss Alpine Club, 2022b). This shows how refuges can indeed be ‘sentinels’ of climate change (Refuges Sentinelles – Refuges laboratoires de haute montagne, n.d.).

Despite these efforts, some huts are still forced to shut early in the season, as was the case with the Chanrion hut in 2018, for example (Christinaz, 2018). Though heliporting water can be used in rare cases, it is not seen as a sustainable water source (Rausis, 2022; Vuilleumier, 2014). Both of these measures should be seen as reactionary adaptations, rather than as sustainable in the long-term.

#### 2.3.3.4 Coordination Among Players

For mountain huts to be able to adapt to the changes in seasonality, especially at the beginning of the season, Miczka suggests a need for coordination among the various players (2022). Access roads, passes, and lifts need to be opened and operational simultaneously; otherwise, opening the huts becomes pointless. This interconnectedness calls for a planned and formal adaptation, where all actors collaborate closely. Such coordination ensures that all necessary infrastructure is in place and functional, allowing the huts to open in response to the conditions in the mountains. In spite of this

increasing need, the current hut governance and hut warden model does not allow for much flexibility in the face of seasonal shift (Miczka, 2022).

#### 2.3.3.5 Opportunities to Diversify

Though not always directly linked to negative impacts of climate change, some huts look to bring in more people by diversifying the activities that are linked to hut frequentation. These can include adapting hut infrastructure to be able to host training events (Saleinaz, Orny), being accessible by mountain bike, or having climbing or via ferrata facilities in close proximity to the hut. These activities bring a different group of people from the traditional alpinist clientele (Miczka, 2022).

Another interesting case study is that of the Panossière hut, where a suspended bridge was built over the glacial valley in order to retain access to the hut, due to glacier mass loss. By avoiding crossing the glacier, this infrastructure has enabled a new clientele to access the hut. Especially interesting for this thesis is that this includes mountain leaders (and their groups), for whom travel on glaciers is not within their scope of practice (Miczka, 2022).

## 2.4 Research Gap: Impacts and Adaptations of Mountain Leaders to Climate Change

As yet, there is little research investigating the effects of climate change directly on mountain leaders in the Alps or elsewhere. The French Alps-based report by Carlson et al. (2021) addresses both guides and mountain leaders, however most of the content about changes and risks is aimed at high altitude environments, where mountain leaders do not practice. The report does however point out that both guides and mountain leaders are 'privileged witnesses to the changes' in the mountains, as well as being 'symbols of the cultural and natural heritage that is under threat' (Carlson et al., 2021, p.37, own translation).

The research gaps both for this topic and the specific study terrain are therefore evident. In the Alps, Clivaz & Langenbach's paper is the only one which specifically addresses mountain leaders, but it does not cover climate change (2020).

## 2.5 Problem Statement and Research Question

Given this context, researching mountain leaders facing climate change in Switzerland is highly pertinent. The research question of this paper is therefore: **What are the impacts of climate change on the mountain leader profession in Switzerland, from training to services? What are the resulting adaptation strategies, in their varying dimensions and forms?**

## 2.6 Objectives and Hypotheses of the Research

As both the research question and the literature review suggest, the relationship between climate change and the mountain leader profession has two dimensions: impacts and adaptations. The following objectives and hypotheses are inspired by the literature review, as well as the author's personal experience training to be a mountain leader. This research aims to understand how climate change impacts mountain leaders, and then identify adaptation strategies (in place or potential) to mitigate or benefit from these changes. Given that the effects of climate change on mid-mountain regions differ from those in high mountains, this research specifically focuses on how changes in mid-mountain areas impact the profession.

A first hypothesis (**H1)** is that **changes in seasonality** will also affect mountain leaders, based on a similar impact to guides. This would most likely be seen in the decrease in cover and duration of the snowpack, especially at mid to low altitude. This is expected to reduce the window of acceptable conditions for leading snowshoe tours. Another way which seasonality might have an impact on mountain leaders is the increasingly high temperatures observed in the summer season. The increasingly arduous conditions for clients to hike in might be a challenge faced by mountain leaders.

Secondly, **H2** suggests that, though perhaps to a lesser extent than guides, mountain leaders will also face **increased hazards** in the mountain terrain due to climate change. This research aims to understand the threat that such events pose to mountain leaders and their clients. This research expects that **hazard mapping** and planning could serve as valuable tools in decision making and preparedness (**H3**).

Adapting to the impacts raised in H1 and H2 leads to hypothesis **H4**, which suggests that mountain leaders may implement **activity or spatial substitution**, changing activities or locations to find more suitable or safer conditions. In a similar way to guides, mountain leaders will need to devote more time to **assessing** weather and environmental **conditions (H5)**.

Linked to H4 is **H6**, which considers it a strength of mountain leaders that they inherently have the flexibility and creativity to offer a wide range of activities and experiences. This facilitates **diversification** in activities or experiences, which is a strategy observed in both mountain huts and guides.

Another hypothesis (**H7**) is that glacial retreat uncovers **new terrain** for mountain leaders to practice in, thus increasing their working territory. Though we are also seeing adjustments in **vegetation** in response to climate change, this research expects a minimal impact on mountain leaders (**H8)**.

In terms of formalized planned adaptations, it is expected that discussion on climate change issues and adaptation strategies will be included in the **mountain leader training** (**H9**). Future mountain leaders

will be given tools to better assess conditions and find ways to continue to practice despite various climate-related challenges. The grey literature seems to show that this is already underway to a certain extent in Switzerland, but is not verified.

A final hypothesis **H10** is that, given the **interpretative role** of mountain leaders, especially in Switzerland, they can be sentinels of climate change, in a similar way to mountain huts. Mountain leaders can integrate climate change issues into their environmental talks with clients, showing the effects on geomorphology, flora, and fauna. Mountain leaders are some of the best-placed to inform and discuss issues related to climate change in the mountains, and it should be seen as an opportunity to be taken advantage of.

## 2.7 Study Terrain: Switzerland

The study area for this thesis is the mid-mountains of Switzerland, be it the Swiss Alps or the Jura. More precisely, it is defined by the scope of practice laid out by the legislation for the mountain leader profession in Switzerland (c.f. 4.2). This country was selected due to its significant geographic, cultural, and economic role in outdoor tourism and recreation.

Switzerland, renowned for its stunning landscapes, has been popular ever since the start of mountain tourism. Guided mountaineering activities play an important role in Switzerland's tourism industry, and the legislative structures around guiding have been around since the first half of the 19$^{th}$ Century (Clivaz & Langenbach, 2020). More recently, in 2011 a legislative and formative framework for 'accompagnateurs' has been developed in Switzerland, with steadily growing interest. As seen in previous sections, climate change in this area poses specific challenges which directly impact outdoor tourism, and mountain leaders specifically.

## 2.8 Methodology

The principal method for this study is an online quantitative survey, supported by some semi-structured interviews. The choice of method is supported by similar studies, notably those that have looked at mountain guides adaptations to climate change, and used similar methods (Bourdeau, 2014; Hanly et al., 2023; Mourey et al., 2020; Rushton & Rutty, 2023; Salim et al., 2019).

### 2.8.1 Survey

The survey (appendix A) was sent to the 524 active members of the Association Suisse des Accompagnateurs-trices en Montagne (ASAM), through the ASAM membership emailing list in December 2024. The winter was chosen as it is the least busy time for such mountain tourism-based

professionals, allowing them time to assess their activity (Mourey et al., 2020). The survey was a Google Form, available in English, French, German and Italian. It was comprised of 45 open and closed questions, with multiple choice or scalar answers. The survey was divided into sub-topics that addressed different aspects of their activity, how they were impacted by climate change, and how they tried to adapt. The first part asked questions about how they organized their work, the type of jobs they did, their clientele, area, etc. The following section contained questions about how they perceived and were impacted (both negatively and possibly positively) by climate change within their profession and practice area. The third section inquired about their adaptation strategies, what they had put in place in response to the aforementioned impacts, and about any integration of climate change discussions with clients.

A total of 104 mountain leaders responded to the survey. This represents a response rate of approximately 20% of the total population, indicating a reasonably representative sample. Based on a 95% confidence level, this sample size yields an estimated margin of error of approximately ±8.6%. Nearly all completed questionnaires were fully usable for analysis. The sole exception was one response (S73), in which the final third consisted primarily of critical comments about the questionnaire itself rather than substantive answers to the survey questions. A detailed presentation of the sample characteristics will be provided at the beginning of the results section, including descriptive statistics for key survey questions.

For the analysis of spatially related data, it is important to note that respondents were given an open-ended question to report the regions in which they work. They were free to list multiple regions, and in some cases, areas outside the defined study zone were reported. Additionally, participants could select up to three altitude ranges in which they most frequently operate. While this approach provided flexibility and captured the diversity of individual practices, it limited the potential for precise spatial analysis. This methodological limitation should be taken into account in the interpretation of the results presented in the following sections.

The qualitative analysis of the open-ended survey responses was conducted through an inductive coding process. Initially, all responses were read in full to gain a comprehensive understanding of the content. Recurrent ideas and observations were identified and developed into a set of codes, which captured specific types of responses. These codes were then grouped into broader thematic categories, for example, environmental impacts such as rockfall, landslides, or fallen trees were grouped under one category, while more sociological issues, such as increased tourist frequentation, formed another. Once this coding framework was established, the questionnaire responses were reviewed a second time to systematically highlight and code all relevant content. The coded data was entered into a spreadsheet, with each code represented as a column and organized according to its overarching thematic group.

This allowed for consistent tracking of respondent quotations and associated topics. A sample extract of this coding framework is included in the annex. The same set of thematic categories and codes was applied to the analysis of the semi-structured interviews, ensuring consistency across both qualitative data sources.

The quantitative analysis focused primarily on the closed-ended survey questions, but also incorporated elements of the open-ended responses. Various statistical tests (see section 2.8.3 for more details) were conducted using RStudio to explore potential relationships between variables, particularly between thematically relevant questions (e.g., observed environmental changes, adaptation practices) and demographic or professional variables (e.g., years of experience, type of employment, gender). In addition, selected open-ended responses were transformed into binary variables to allow for their inclusion in the quantitative analysis. For example, the presence or absence of references to specific impacts or adaptation strategies was coded, enabling these qualitative elements to be analysed statistically. This approach aimed to identify statistically significant associations and patterns that could contribute to a typology of mountain leaders or reveal meaningful trends in perceptions and practices. A range of statistical tests were performed; however, as is common in exploratory research, not all yielded statistically significant or interpretable results. Nonetheless, both significant findings and notable trends (even if not necessarily statistically significant) were retained and are presented in the results section. These findings helped to inform and complement the qualitative analysis by adding quantitative depth to the identified themes.

### 2.8.2 Semi-structured Interviews

Eight semi-structured interviews were conducted to deepen the understanding of the themes that emerged from the questionnaire responses. The selection of participants was based on a two-fold approach to represent the diversity of the candidates, rather than the majority.

First, general demographic factors were considered to ensure a broad representation, including age, gender, and geographic location within Switzerland. These basic criteria were used to reflect the socio-professional variety among mountain leaders. Second, a preliminary analysis of the questionnaire data guided the selection of more nuanced variables likely to influence perceptions and adaptations to climate change. For example, professional experience appeared to play a role in both the recognition of environmental changes and the strategies employed to adapt to them. Similarly, the distinction between mono-active and pluriactive mountain leaders emerged as significant, meaning those who work solely as a mountain leader and those who have other professions on the side. Given that the majority of respondents reported being professionally pluri-active, only one interviewee was selected who worked

solely as a mountain leader. This combined approach aimed not to reflect the statistical majority of mountain leaders, but rather to capture a diverse range of profiles likely to yield varied perspectives.

The interviews took place after receiving the responses to the questionnaire, and were conducted during the month of March 2024. The interviews followed a predetermined set of open-ended questions, allowing for both structure and flexibility, and explored themes from the questionnaire in greater detail (Hanly et al., 2023). The interviews were fully transcribed and then analysed qualitatively the same codification process as the open answers of the survey, as described above.

### 2.8.3 Statistical Analysis

A range of statistical tests was used to explore relationships between variables found in the survey data, and chosen based on the type and distribution of the data.

The most basic analyses involved Chi-squared tests of independence, which were used to examine associations between categorical variables. For example, these tests assessed whether the use of a specific adaptation strategy varied by altitude or geographic region. Analyses were limited to 2x2 contingency tables where both variables were binary. For example, they do or don't work in the Prealps, and they do or don't use spatial adaptations.

Spearman's rank correlation was used to assess monotonic relationships between two continuous or ordinal variables. This method was chosen, for example, for evaluating whether individuals who found winter adaptation more difficult were also those who perceived customers to be less willing to adapt, as both measures were based on an ordinal scale of 1 to 10.

To examine potential differences in a continuous or ordinal outcome across more than two independent groups, non-parametric Kruskal-Wallis rank sum tests were applied. For instance, Kruskal-Wallis tests were used to assess whether profitability differed by number of days worked, and whether adaptation difficulty was associated with profitability in both summer and winter. Similar tests were also conducted to explore the relationship between emotional responses and the perceived need for future adaptation. Where these tests revealed significant effects, Dunn's post-hoc tests with Bonferroni correction were used to identify which specific groups differed. This approach was applied, for example, when examining the relationship between adaptation difficulty levels and perceived profitability impact in both summer and winter.

### 2.8.4 Use of Artificial Intelligence

Throughout the writing of this thesis, artificial intelligence (AI), specifically OpenAI's ChatGPT as well as Deepl Write, was used as a writing and structuring support tool. The AI was primarily used to suggest improved phrasing, while the author provided thematic direction, content structure and selected quotes from qualitative data (interviews and surveys). The AI then assisted in composing coherent, academic prose based on these inputs. Care was taken to ensure that the content remained as original as possible, with AI-generated suggestions being critically assessed and edited to reflect the author's tone. AI was not used to generate new empirical data, but rather to help articulate and organise already collected semi-structured material. AI was also employed during the statistical analysis phase to help provide R code to visualise the data as requested. Using AI was instrumental in improving the clarity, coherence and efficiency of the thesis-writing process.

In summary, this mixed-methods approach allowed for a comprehensive understanding of how mountain leaders perceive and respond to climate change. Quantitative analyses provided patterns and correlations across a broad sample, while qualitative insights enriched these findings with depth and nuance. The coding structure used for open responses ensured consistency across both data types, and the integration of qualitative codes into binary quantitative variables allowed for meaningful cross-analysis. The combination of statistical rigour and thematic exploration aimed to build a grounded yet adaptable typology of professional responses to environmental change.

# 3 Results

The results from the survey and the interviews will be split into three main parts. Firstly, a brief overview of the sample characteristics will help to get a feel for those who responded. Secondly, the results found for the impacts of climate change on the profession will be explored, followed in the third section by the adaptation strategies adopted by mountain leaders.

## 3.1 Sample Characteristics

The following graphs help to give an overview of the 104 respondents that make up the sample. Figure 11 shows how many mountain leaders report working in one or more of the main regions in Switzerland (important to remember one ML might work in multiple regions).

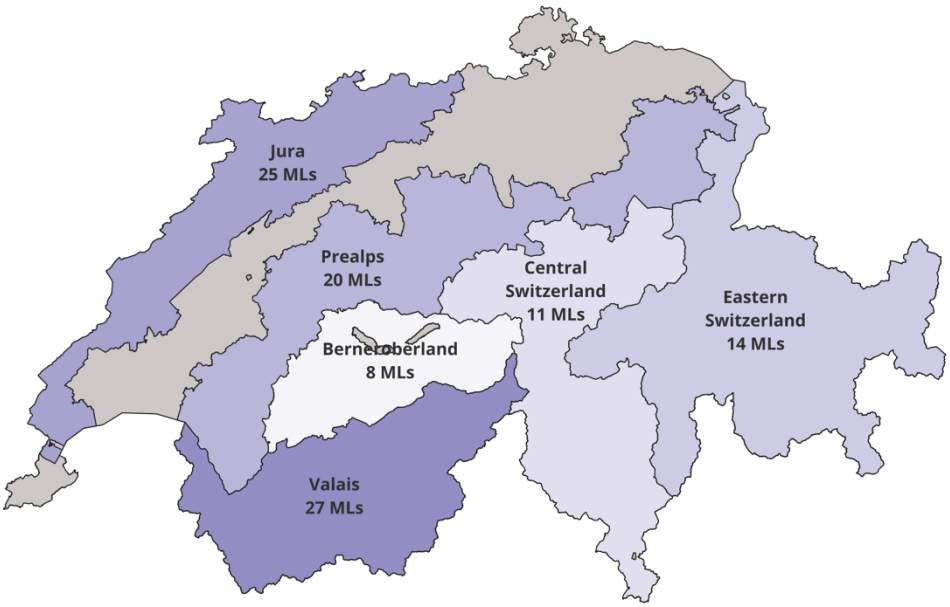


*Figure 11: Geographic distribution of where mountain leaders report working in Switzerland.*

A great majority of mountain leaders exercise this profession alongside at least one other, with only a small portion being mono-active (Figure 12). The level of experience is quite varied, with two thirds of the respondents having less than 10 years' experience as a mountain leader (Figure 13). 17% percent of mountain leaders with less than two years' experience demonstrates a large growth in the profession in recent years.

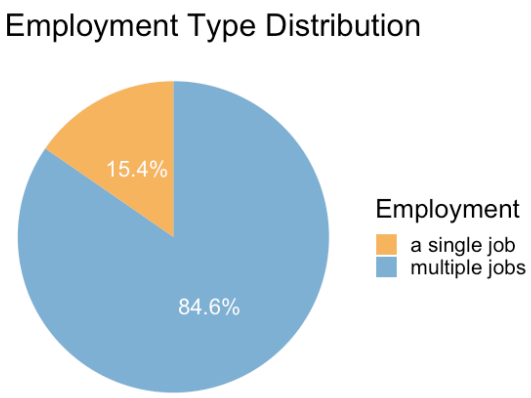


*Figure 12: Employment type distribution*

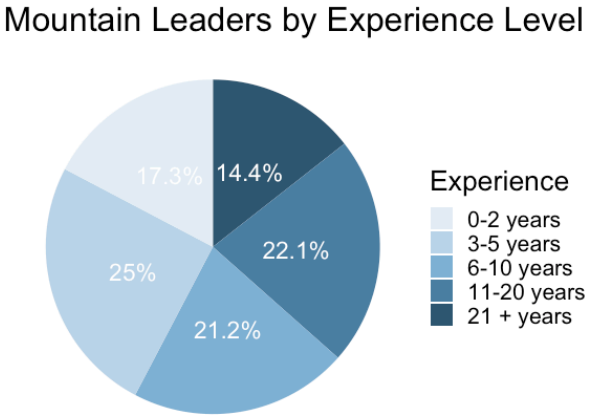


*Figure 13: Mountain leaders by experience level*

As to the type of work and seasonality, almost two thirds work less that 50 days a year as a mountain leader (Figure 14). Only very few work more than 151 days, even though 15 percent say they only work as a mountain leader. In this sense it is obvious that most mountain leaders in Switzerland do not rely on this as their main source of income, though this is not the case for everyone.

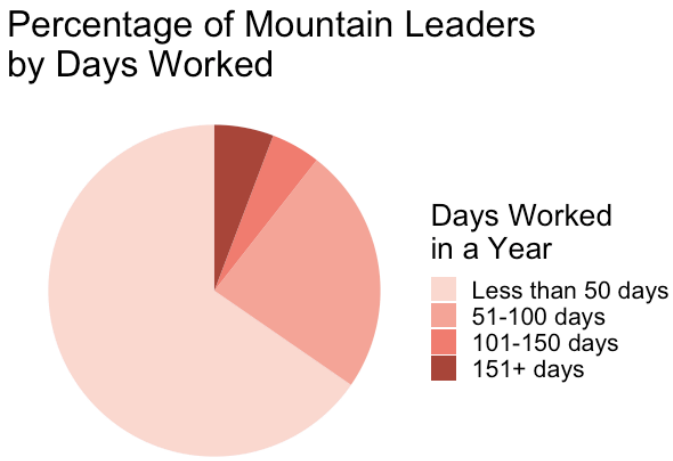


*Figure 14: Percentage of mountain leaders by days worked.*

The majority of respondents report working the most over the peak summer months (June to September), but January and February are also common months to work in in winter (Figure 15). A very small minority say that December is one of their most busy months as a mountain leader.

The altitude worked at is mostly between 1000 and 2500m, with the most frequent level being between 1500 and 2000m, which represent well the mid mountain range (Figure 16). Some mountain leaders do work at lower elevations, and a few at higher, but the main work is done around the tree line.

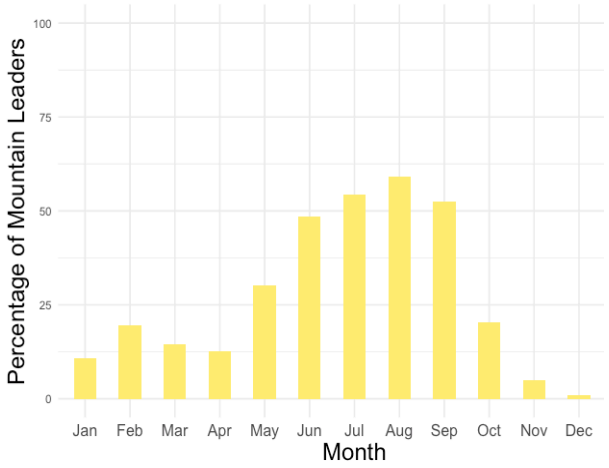


*Figure 15: Months most frequently work in.*

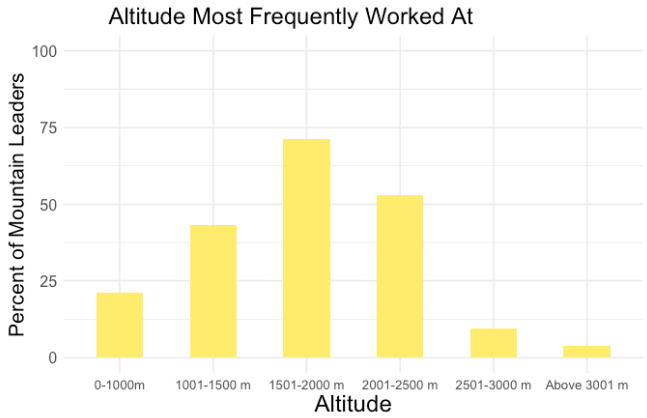


*Figure 16: Altitude most frequently worked at.*

## 3.2 IMPACTS OF CLIMATE CHANGE

The survey and interviews revealed multiple ways in which climate change is affecting the profession of mountain leaders. These impacts are categorised into several thematic areas, as shown in Figure 17. The first concerns direct changes in weather and climatic conditions, followed by those specific to the winter season, linked to exactly such altered seasonal patterns and rising temperatures. Subsequent sections explore how these climatic shifts affect the natural environment more broadly, such as changes in flora and fauna, as well as the increase in geohazards like landslides and rockfall. These secondary impacts often lead to path closures, which are examined in detail. Finally, changes in mountain use, particularly the growing frequentation of certain areas, are discussed.

**Climate change**
**IMPACTS THE MOUNTAIN LEADER PROFESSION**
**by creating changes in...**

| Weather and Climatic Conditions | The Winter Season | Seasonality | Fauna & Flora Habits | The Environment |
|---|---|---|---|---|
| • Increased temperatures<br>• Increased extreme weather events<br>• Flooding<br>• Drought | • Regional disparities and rise of the snow line<br>• Increased unpredictability linked to snow<br>• Increased avalanche risk | • Seasonal transitions less predictable | • Rise of species to higher elevations | • Landslides<br>• Rockfall<br>• Fallen trees<br>• Resulting path closure |

*Figure 17: Summary table of the impacts of climate change on the mountain leader profession*

There were 12 respondents who did not report noticing any changes in summer. Two female respondents who had very little experience report not being able to comment, since they have not been able to assess over a long enough time. Otherwise, the typology of those not noticing changes were men over the age of 45, representing about 1 in 6 men.

### 3.2.1 Changes in the Weather and Climatic Conditions

#### 3.2.1.1 Increased Temperatures

Perhaps the most widely recognised consequence of climate change is the rise in global temperatures. As noted in the introduction, temperatures in Switzerland have risen and will continue to rise (NCCS, 2018), with proportionally greater warming at elevation (Rebetez & Reinhard, 2008). It is no surprise,

therefore, that the trend is felt by those working in the mountains. Several mountain leaders mention increasingly hot weather, especially in the summer months, when there are days when ‘it gets really, really hot’ (I4), with some even describing the conditions as ‘extreme’ (S89). In such conditions, hikes can be directly affected (S29), not only due to general discomfort but also because of heightened health risks such as dehydration and heat stroke.

However, increased temperatures are not universally viewed as being entirely negative by mountain leaders. A few acknowledge some upsides ‘Yes, it's warm, it's warm. A lot of time it's warm and it's okay to walk. Okay, it's kind of too warm, too heavy warm, but that I see as a little bit positive’. (I6) Another noted that while they do not seriously see any opportunities of climate change, that ‘sometimes it's nice to be able to sit outside the hut in the evening in summer at higher altitudes and not freeze...!’ (S74).

#### 3.2.1.2 Increased Extreme Weather Events

A significant number of mountain leaders report notable changes in storm activity and precipitation patterns, particularly in terms of increased frequency, intensity, and unpredictability. One respondent highlights ‘the increasingly frequent and intense heatwaves and thunderstorms (S10) as key environmental factors affecting their work in summer. Others note the ‘very strong storms’ (S7), the ‘force and violence of thunderstorms and rain/hail’ (S19), ‘heavier and more frequent thunderstorms and showers’ (S33) as well as ‘more violent and unpredictable storms’ (S49). A number of mountain leaders also mentioned the trend of ‘precipitation [being] more volatile (large amounts in a short period of time)’ (S81), along with ‘short but heavier localised rainfall’ (S64).

These changes are directly affecting how mountain leaders plan and carry out their work. ‘We had summers where there were thunderstorms every day […]. This is a super big issue.’ (I8) ‘Sometimes excursions have to be cancelled because of uncertain weather conditions (risk of violent storms)’ (S2). One interviewee described the impact over time: ‘In any case, the force of the bad weather, the fact that all of a sudden there's this really strong erosion, it's this washing […] I think it's been for around 10 years. And it's getting worse. I think it's getting worse.’ (I3)

As well as inducing logistical challenges, unpredictable thunderstorms can induce stress for mountain leaders, who are responsible for the safety of themselves and their group. As one interviewee reflected, ‘This is a huge stress for me. I'm really afraid of thunderstorms. And we are usually on mountain tops.’ (8), highlighting the emotional stress of managing groups with volatile weather in the mountainous environments.

#### 3.2.1.3 Flooding

Flooding and debris flows are increasingly cited by mountain leaders as disruptive and potentially hazardous consequences of climate change. These events are closely tied to the rise in intense, short-duration precipitation episodes, as explained above. One mountain leader relates how they, 'had to pay attention to a risk of flooding' (I1), as many respondents report an increased 'risk of flooding' (S34). Another describes how 'really strong precipitation […] floods away a lot of material' (I4), highlighting the immediate erosion that such rainfall can cause. These events often alter the landscape rapidly, as one explains, 'a few days after heavy rain, we notice the course of a torrent has changed' (I7). These phenomena can be observed by alterations in water flow and sediment movement, such as 'very strong changes to watercourses (gravel)' (S81) and 'flooded streams after rain' (S98). In some areas, debris flows have become a recurrent concern: 'Debris flows as a result of increased heavy precipitation' (S97).

The practical consequences of these hydrological events are significant. Rapid flooding, swollen streams, and altered riverbeds can create both immediate safety risks as well as limit the feasibility of certain outings. In some cases, mountain leaders report needing to modify or cancel planned activities due to such risks: 'I had to change location at the last minute because of the risk of flooding' (S8) (we will address adaptation to these events more later on). Even when flooding does not create overt danger, it may lead to temporary inaccessibility if paths or crossings are rendered inaccessible. Others point more broadly to 'more wind uprooting, more flooding and more landslides' (S104), situating these phenomena within a larger pattern of instability across mountainous terrain linked to increasingly erratic and extreme weather events. As these events become more frequent, they pose an increasing challenge to the day-to-day planning and safe execution of outings organised by mountain leaders.

#### 3.2.1.4 Drought

Whilst there are some extreme precipitation events, there are also 'long dry summers (72)', and these periods without water can cause drought in the mountains. This was raised by a few mountain leaders, one of whom wrote of one of climate change's impacts as being 'rain, drought, at times when it's not normal (S12)'. Another respondent noted 'less water all the time' (S13), suggesting that the problem of drought during certain periods is increasing. The problem is often associated with needing to find water for usage, 'Because climatically speaking, what has changed with the droughts of the last two or three years is that we have water problems. So we have fountains that no longer flow, we have huts that no longer have water. […] But I've also found dry torrents, in places where I expected to have water and then there wasn't any.' (I3) As mentioned in the introduction, this is a problem for some mountain huts,

which then also impacts those staying in the huts: ‘Some huts are starting to lack water even at mid-altitudes’ (S19).

### 3.2.2 Changes in the Winter Season

The changes raised by mountain leaders in the winter season, notably linked to snow cover, are multiple and complex. Topics such as less predictable snowfall, changes in seasonality, generally decreased snow cover, and rise of the snow limit came up regularly throughout the survey and interviews.

#### 3.2.2.1 Regional Disparities and Rise of the Snow Line

These changes are not only environmental but also directly affect how professionals operate during the winter months. One respondent summarises: 'the winter is more difficult, for questions of snow cover' (I2). Others speak more directly to a general decrease in snow: 'snow goes away faster' (S49) especially in regions at lower altitudes. ‘And then, in winter, there's a lot less snow. I hardly ever go snowshoeing any more. It's practically impossible. I'm a bit far from the big centres, the big snowy valleys. But it's far too unpredictable.' (I7) This quote shows the **regional disparity** of snow cover. The Jura, for example, used to get long snowy winters, but in recent years ‘in the oriental part, the Basel Jura, in winter you maybe have 3–4 times good snow in winter. So I decided there was no point' (2). This aligns with a general **upward shift of the snowline,** or ‘rise of the snow limit’ (S67) with the snow cover moving to ‘higher altitudes’ (S69). Especially for mountain leaders who usually work at lower altitudes, which is often linked to where they live, this can become a problem. This was the case for one mountain leader, who is based in the Jura, and explains that ‘My primary residence is in the Bâle region, and I would offer snowshoe tours in the Jura, and I realized it wasn't possible anymore.’ (I2) Another respondent explains that over the last decade they have experienced a ‘Yo-yo rain-snow-rain phenomenon at increasingly higher altitudes (S36)’, meaning that not only does snow not necessarily fall, but that if it does, it might directly be followed by wet precipitation. The lack of (lasting) snow in regions of lower altitudes can truly cause problems. The exact change remains subjective. According to one respondent, who usually works between 1500-2500m, now they have a ‘lack of snow below 1800 meters above sea level’(S68), while another who works at similar altitudes puts the limit even lower, saying that there is ‘almost or no snow at 1300m’ (S3). The consensus, however, is of generally ‘much less snow in mid-mountain areas (S2)’, and that the precipitation alternates between snow and rain. This has direct effects on planning, notably for snowshoe tours, the big part of which can cause problems for planning snowshoeing trips, since ‘No snow = no snowshoe tours’ (S70). Though this is not as black and white as it may appear, as we will see in the part about adaptation, there are trails that can no longer be guaranteed with snow: ‘Some snowshoe tours are not possible at lower altitudes’ (S83). As another

mountain leader puts it: 'there are snowshoe trekking departure areas that... are no longer snowshoe trekking departure areas. You clearly need to go higher' (3). This means that in some areas, if it is not possible to go higher, like in the Jura for example, snowshoeing is no longer viable: 'I haven't done any hikes in the snow' (I1).

#### 3.2.2.2 Increased Unpredictability Linked to Snow

**Unpredictability** is a recurring theme in how respondents describe snow cover and snowfall. Several mention the difficulty in planning, due to irregular snowfall: 'Sometimes [it snows] earlier in November, then you don't have any over the holidays in Christmastime, no snow. Then it comes in January, February comes a lot of snow again [...] And then in February, March, you don't have a lot of snow because it doesn't snow' (I6). Whereas seasonal rhythms might have seemed well established in the past, recent years have been marked by increasingly erratic snowfall patterns, both in the timing and quantity of snow. This shift creates substantial difficulties in planning snowshoe tours, as highlighted by one mountain leader: 'There's less and less snow, and it's very difficult to organise snowshoe hikes because we never know if there will be snow.' (S7)

This challenge is widely echoed across responses. For many, it is no longer possible to offer a stable winter calendar: 'It's almost impossible for me to offer a calendar of snowshoeing tours with good perspectives of actually doing them' (S24), and 'It's a bit like the lottery when we plan the programme of outings in winter, and we can't promise snow anymore' (S20). Others emphasise that 'snowshoe tours can no longer be reliably planned' (S72), or must now be arranged last-minute: 'Snowshoe tours take place at short notice, depending on the conditions. Customers no longer plan far in advance.' (S72). These difficulties are compounded in particular regions, such as the Jura or the Pre-Alps, where snowfall has become too inconsistent: 'Since 2016, there has been less and less snow in the Jura in winter, making it almost impossible to plan a snowshoe outing and be sure of having snow.' (S38), and 'Highly fluctuating snow conditions at medium altitudes, making it difficult to plan snowshoe hikes in the Jura or Pre-Alps in advance' (S44).

This growing unpredictability is not only a logistical challenge—it also indirectly affects the **quality** of the experience that guides are able to offer. As one interviewee explains, ‘Like everyone who does snowshoeing, snowshoeing is great when there's fresh snow, but when it's hard, when there are rocks, it's not very interesting. So I think it's becoming increasingly difficult to offer outings that are actually enjoyable.’ (I2) In other words, while a certain threshold of snow is necessary to run snowshoe tours at all, the perceived quality of the outing depends on more specific conditions. Respondents highlight the importance of soft, fresh snow to ensure a pleasant and safe experience. One respondent notes that ‘snowshoeing on ice is not interesting’ and that, as a result, ‘customers wait to know the snow conditions

before signing up (so last minute)' (S39). This uncertainty directly reduces the window in which trips can be advertised and booked, further limiting the viability of the activity.

In addition to organizational constraints, there is also a certain psychological dimension to these shifts. Several mountain leaders report a **decrease in demand** linked to snow availability, with the absence of a recognisable winter atmosphere that drives clients to book snowshoe tours. As one respondent explains, 'Customers see the lack of snow and can't imagine being able to do a snowshoeing activity.' (S51) Another puts it more bluntly: 'The snowless landscape doesn't make you want to go snowshoeing' (S90). There is a seeming disconnect between the season and the visual environment of customers. The winter conditions don't help to get them into 'snow mode', where booking winter activities is front of mind. For some, this is already having an effect: 'Snowshoe tours used to be a popular offer, but with less snow this tends to disappear' (S87). What emerges is not just a loss of snow, but a breakdown in the conditions—both material and perceptual—that once made snowshoeing a reliable and desirable winter activity.

#### 3.2.2.3 Increased Avalanche Risk

As winter conditions grow more erratic, mountain leaders increasingly point to the rising challenge of managing avalanche risk. Many connect this directly to more extreme precipitation events – whether in the form of punctual extreme snowfall, warm spells, or rain on snow events – which contribute to instability in the snowpack and make avalanche conditions harder to anticipate and navigate.

'Shorter snow cover, variation between heavy snowfalls and nothing' can result in 'avalanche danger [being] more difficult to manage' (S5), one mountain leader explains, highlighting the growing unpredictability of winter weather and the increase in extreme snowfall events. This erratic pattern is echoed by others who observe how fluctuating snow and rain throughout the winter season generate unfamiliar conditions: 'The weather and snow conditions are yo-yoing. Situations are less stable and predictable than in the past (around 10 years). There are new situations that we almost never had before, such as sliding avalanches at the start of the season, early winters with no snow, high altitude rainfalls in the middle of winter and springs with heavy precipitation' (S30). Similarly, another respondent reports 'increasingly less snow locally or critical snow situations with regard to avalanches' (S91), underlining this 'yo-yo' effect.

As well as unpredictable and extreme snowfall, the rise in temperatures is also a common concern linked to avalanche danger, with one respondent giving the example of facing 'greater avalanche risk, as the first snow often falls on ground that is too warm' (S18). More generally, warming temperatures throughout the winter season can destabilize the snowpack, and that in the 'winter, change in temperature increases the risk of avalanches' (S46). Several respondents observed how the decrease in

snowpack stability linked to temperature has increased temperature related avalanche mechanisms, with one mountain leader observing that ‘Spontaneous or slab avalanches [are] more frequent’ (S41). The result is an environment in which avalanche risk does not follow familiar seasonal patterns, given the temperature and precipitation variation within the season. As one guide notes, risk now emerges in windows previously seen as relatively stable: ‘Avalanche danger in the daytime already in Jan or Feb, not only in the spring months’ (S71).

These changes have a direct impact on the planning and realization of the winter outings calendar, particularly in relation to planning safe snowshoe tours. One mountain leader summarizes how overall ‘the danger of avalanches is more difficult to manage’ (S49). As avalanche risk becomes harder to anticipate and less bound to typical seasonal rhythms, mountain leaders are increasingly challenged to reassess how and when they can safely guide in the winter landscape.

### 3.2.3 Changes in Seasonality

Whether it be late snows in the spring or early snows in the autumn, the results suggest that **seasonal transitions** are becoming less predictable than they used to be, though opinions differ on exactly how this plays out. Some mountain leaders experience later snows in the spring, causing more difficult access at the start of summer, while others seem to have opposite experiences, with the snow melting faster at the end of winter, leading to snow free zones sooner than in the past.

One respondent notes: ‘It's funny, because I think the shorter winter has moved. Clearly, winter starts later, but in fact, April-May, higher up, the tours that we were already able to do a little higher, that melted or whatever. This is less the case now. In other words, I find that I've had more snow in recent years’ (I3). This is often linked to lingering snowfields, or névés, well into the start of summer: 'what's changed is that, in terms of safety, the névés are bigger' (I3). In some cases, this has impacted the beginning of summer activities: ‘I know there was a good hard winter or of the ending of the winter in 2019. Yes, starting the summer was a lot of snow high up there. And I couldn't make some hikes in May to middle June, I have to make another hike to the home.' (I6).

On the other hand, some mountain leaders note earlier access to high-altitude passes – the ‘snow goes away faster’ (S49) and ‘the main change is the snowmelt, the passes are accessible earlier and close later.' (S102). Similarly, others point to earlier snow-free conditions at lower altitudes: ‘In lower regions, because of the temperature, it's snow free sooner’ (S64) and ‘I can go hiking more quickly without having to think about snow’ (S96). These diverging accounts about the transition from winter to summer season highlight the interannual and regional variation, showing that there are certainly

perceived changes in seasonality, but what those changes are will depend on the person, the year, and the area they practice.

The effect of these seasonal changes have a nuanced effect on the length of the summer season, and once again, opinions differ: ‘It doesn't necessarily extend the summer season, because the first snow comes as early as it used to. There can still be low altitude snow as early as September. […] Things are becoming very uncertain. The shortening of the winter season doesn't necessarily benefit the summer season, because often - and I'm sure it's going to happen again - we get terrible snow that makes it impossible to climb to higher altitudes’ (I2). These contrasting experiences suggest that the changing winter season doesn’t follow a simple or consistent pattern. Instead, how these shifts are perceived and felt depends not only on regional differences, but also on the specific contexts and experiences of each mountain leader.

### 3.2.4 Changes in Fauna and Flora Habits

To the trained eye, one of the most visible effects of climate change in mid-mountain environments is the **upward movement of flora**. As temperatures increase, plant species are colonizing higher elevations than previously recorded (Figure 18). This shift has been observed directly by mountain leaders who reported: ‘you can clearly see it moving upwards, the forest moving upwards, clearly it’s moving upwards, plants changing’ (I3). One interviewee summarised the experience as ‘the flora and fauna are “climbing” higher, a gentle change since I started practising’ (S14). Several respondents also noted the appearance of southern or lowland species in unfamiliar locations: ‘there are places, I’m like, oh, what are they doing there?’ (I3), and ‘appearance of new plant species not previously present at these altitudes over the last 2–3 years’ (S2). These ‘new botanical species’ (S32) were seen by some participants as indicative of a broader shift in the range of flora due to rising temperatures. One interviewee, a botanist as well as a mountain leader, notes that ‘but many more [species] that came and arrived. And that's clearly due to warming.’ (I8).

*Figure 18: Multiple species are colonising higher altitudes and slowly raising the treeline (Randin, 2024)*

The same interviewee goes on to say that ‘this is something that I see because of my expertise […] the tree line […] then plants and animals coming out at a time of year, like phenology, phenological shifts, we call that, that the timing of events of animals and plants are not the same anymore.’ (I8), suggesting

changes in the flowering patterns of Alpine flora. Another respondent notes ‘The Alpine flora is [flowering] earlier and often dries out by early August’ (S3), and another ‘activities relating to flora are increasingly limited in time’ (S3). References to ‘early flowering’ (S4), ‘anticipated flowering’ (S19), and general ‘changes in flora’ (41) were frequent, suggesting that this is both a common and consequential observation among practitioners. This increasingly unpredictable timing impacts mountain leader’s activities that rely on seasonal cues. One interviewee gives an example of how these shifts can add complexity in planning themed walks. ‘Next summer, I will have excursions with botanical clubs, say from Basel. And you want to know a little bit ahead what is flowering’ (I8), which she shares is becoming more unpredictable.

Changes in fauna were perceived as somewhat less pronounced by some participants, with one noting: ‘in my opinion, there hasn’t been much change’ (5). Others, however, pointed to behavioural adjustments likely linked to warming, such as altered seasonal patterns and temperature avoidance. For example, ‘Autumns have been warm for around 3–4 years and this has led to changes in the behaviour of animals during the breeding season, such as deer’ (S6), or ‘Marmots withdraw to their burrows in the warm hours of the day’ (S3). These shifts were generally described as subtle and, from the perspective of mountain leaders, do not appear to significantly affected their practice.

### 3.2.5 Changes in the Environment

Climate change has effects on the environment in many ways, but the main ones noted by mountain leaders that have a direct impact on their profession are increased landslides, rockfalls, flooding, and fallen trees. Less directly impactful but also observed is glacial retreat. Figure 19 shows which hazards were most reported by mountain leaders depending on the altitude they most frequently work at. Though none of the hazards were statistically correlated with any given altitude group, it is interesting to note some trends, such as how rockfall seems to get more frequently reported at higher altitudes, and path closures at lower altitudes. Statistical analysis also revealed no trends linking hazards to other demographics such as experience, age or sex.

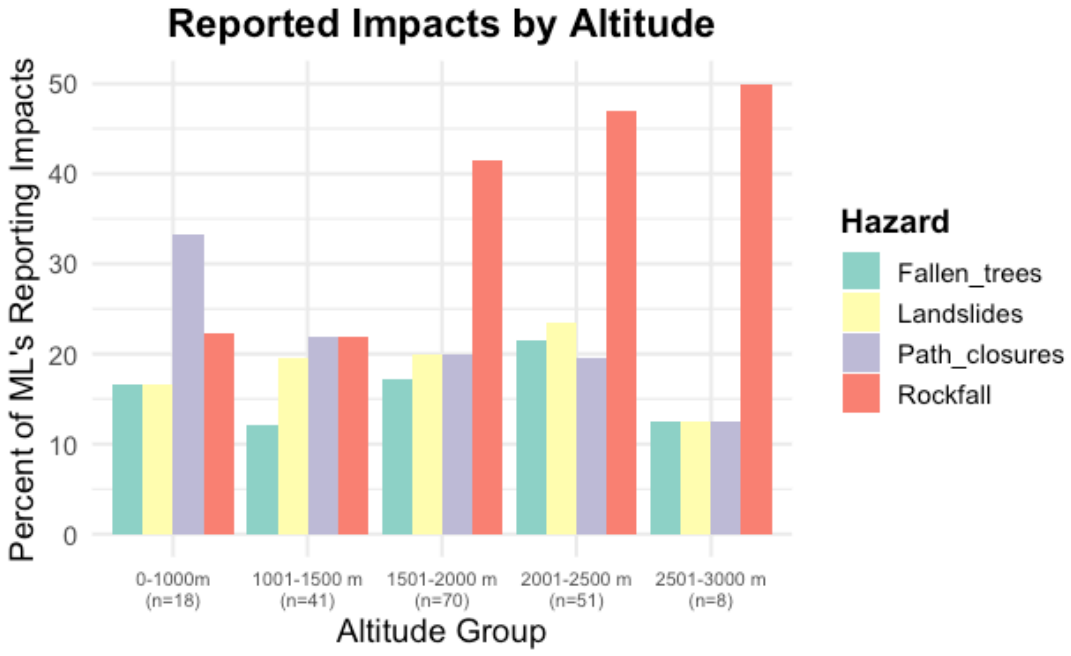


*Figure 19: Reported environmental impacts by altitude group worked at by mountain leaders.*

#### 3.2.5.1 Landslides

According to the survey, 19 mountain leaders report landslides as one of the key climate-related factors affecting their professional activity. This perceived increase is closely linked to more frequent and intense heavy rainfall events, which heighten the risk of slope instability. As one interviewee explains, 'So last year, for example, and the year before that, there were problems with a lot of rain, if you like, and some paths were blocked' (I5). These blockages, often caused by debris flow or terrain collapse, are becoming increasingly common and have a direct impact on route accessibility. A well-known example is that of the Europaweg, a high-altitude trail connecting Zermatt and Grächen, which was

forced to close in July 2024 due to multiple landslides and rockfall in a particularly exposed section (Swiss Hiking Federation and Cantonal Hiking Associations, 2024). These kinds of closures underline the extent to which route continuity now depends on increasingly unstable terrain conditions**,** which can become increasingly problematic on set tours such as the Europaweg and the Haute Route or other popular tours that mountain leaders are often hired to lead.

Other survey respondents echo these concerns, pointing to 'increased erosion, rockfall, more frequent extreme precipitation' (S67) and a rise in 'landslides and unstable areas' (S23) over the past few years. In some cases, these events render paths impassable altogether: 'Increasingly impassable routes due to rockfall, landslides, etc.' (S62). In this sense, landslide activity often demands last-minute adjustments. One respondent describes how 'route changes due to landslides, [make] the degree of difficulty increase' and notes that changes are 'necessary at short notice' (S88). These observations highlight how landslides complicate the planning and execution of guided tours, particularly in mountain terrain where few alternative routes exist. Though the broader theme of path closures is addressed later in this thesis, it is important to underline here that landslides are one of the primary drivers behind such disruptions.

#### 3.2.5.2 Rockfall

Rockfall is another impact that over a third of mountain leaders reported having increased over the past years, making it the most reported environmental impact reported by mountain leaders. They identify two main ways in which this gravitational process affects their work. The first is as **a direct safety hazard**, particularly when guiding groups through steep or narrow sections of trail where rocks may fall from above. Even relatively small-scale events can be dangerous: as one leader puts it, 'there are more stones that fall onto the paths' (I5). With 'much more rockfall' comes 'the associated uncertainty and noise' (S71), increasing stress for leaders when having to cross such 'sensitive passages (S14). Another mountain leaders notes how such occurrences create 'more uncertainty about the state of the paths' (S3), adding to general unpredictability of conditions. The unpredictability of when and where rocks may fall increases the level of risk when planning and executing hikes, as well as increasing stress levels for the leader during the hike. The second effect of 'increased rockfall and landslides on hiking trails' (S64) is more practical: when events are large enough, they can block, damage, or even **destroy sections of path**. In some cases, trails are rendered unusable, contributing to the phenomenon of 'increasingly impassable routes due to rockfall, landslides, etc.' (S62), and leading to closures or rerouting.

Rockfall is often associated with high alpine zones, such as one mountain leader notes: 'In summer, I can see a lot of rock falling events, especially the north sector above 3000 or 2500 meters' (I4), pointing to the destabilising effect of permafrost melt in upper zones. Indeed, several respondents associate

recent increases in rockfall with thawing permafrost and warming at altitude, which loosens previously frozen rock faces: ‘more unstable glaciers, rockfall and rock slides due to permafrost loss’ (S58). However, many others report a rise in rockfall activity despite working primarily below 2500 meters, suggesting that this is not exclusively a high mountain phenomenon. Instead, more frequent heavy rainfall events appear to be a growing driver of slope instability, even in mid-mountain environments. One respondent links the increased risk to ‘more unstable weather in recent years’ (S47), while another cites a mix of rainfall and erosion as contributing factors to path closures: ‘erosion, destruction of footbridges, rock falls’ (S14). As such, rockfall has become a widespread concern across elevations, reflecting broader shifts in weather and terrain stability, and contributing to access issues.

#### 3.2.5.3 Fallen Trees

Although perhaps less immediately associated with climate change, fallen trees have emerged as a recurring and growing issue for mountain leaders. 18 respondents point to an increase ‘fallen trees’ (S29) onto or near trails, particularly in forested areas, and often as a result of, once again, extreme weather events. One mountain leader reports, ‘risk of trees falling due to stormy winds’ (S9). This presents both a **direct safety hazard**: ‘In summer, beware of falling trees on forest paths’ (S46), as well as a logistical one, as such **obstructions can block path access**, sometimes unpredictably. One interviewee reflects, ‘And then there are the unexpected things. […] You have more unforeseen events or trees that have fallen on the path that you have to try to get around. It can be complicated’ (I2).

*Figure 20: A hiking trail near Saxon blocked by fallen trees following the late snows of the 17th of April 2025 (Vouillamoz, 2025)*

These complications are particularly evident in the experience of one mountain leader who reports frequent encounters with fallen trees due to storm damage: ‘This is often linked to bad weather, storms that break trees in the forest’ (I3). They explain that ‘with the climatic hazards, the wind, the sudden storms like we have more of, and especially the sudden snowfalls, that's also what makes it happen. Enormous amounts of snow falling on trees, huge weight, a gust of wind, bang, trees breaking, branches…’ (I3), as shown in Figure 20. In their words, this has led to routes becoming almost inaccessible, especially depending on the type of clients that they were leading: ‘I've already said to myself several times, oh shit, I shouldn't have brought them here. It's going to be very tricky, because it was a mikado of trees planted

on a 42° slope [...] And now, well it's pretty gnarly!' (I3). These experiences underscore how extreme weather linked to climate change, be it strong winds or abundant and untimely snowfalls, can result in dangerous or impractical trail conditions. As I3 puts it, 'you have to be prepared to deal with these unforeseen events', meaning 'falling trees' that lead to 'blocked paths, there are more of those too'. Such events have a direct impact on the profession of mountain leaders, increasing safety hazards while limiting accessibility during route planning and execution.

#### 3.2.5.4 Resulting Path Closure

The cumulative impact of hazards such as rockfall, landslides, flooding and fallen trees on the mountain leader profession is often most visible in the increasing frequency of trail closures, a challenge mentioned by over a fifth of mountain leaders. One of the key difficulties they raise is the growing **unpredictability of which trails will be accessible when**. As one explains, 'I cannot be sure if I can walk all the tracks I wanted to walk, or I can do all the things I wanted to do with my clients' (I4). Whether it's a mudflow two days before a tour or flooding that renders a region inaccessible, last-minute disruptions demand a high degree of flexibility in both planning and execution. Another recalls: 'So last year, for example, and the year before that, there were problems with a lot of rain, if you like, and some paths were blocked' (I5). These sudden changes not only challenge logistics but also limit options for offering specific types of experiences. One leader highlights how destinations are not always interchangeable: 'If you want to go to the Binntal, you don't necessarily want to go to Graubünden' (I2).

In addition to this unpredictability, mountain leaders also reflect on **how trail closures are now monitored and communicated**. Many appreciate the increased visibility and responsiveness made possible by tools such as SwissTopo, which allow real-time updates on access issues (Figure 21). As one explains, 'you can see that on the maps in advance... it's the most tangible thing, the closed paths' (I7). At the same time, concerns were raised that closures are now issued more often than in the past, sometimes without a clear or proportional basis. 'The paths are closed more and more often' (I5), one observes, while another suggests this might be linked to how quickly new digital systems are able to react: 'I can see that on SwissTopo there's a lot of paths that are marked as closed... but maybe it's also just the fact that more people are outside and the instruments can react faster' (I4). For mountain leaders, this creates tension between official closures and personal professional judgment. As one puts it: 'Today, we're falling into the trap of over-security. "No, it's closed." I've found myself on closed paths, I was told it's closed, but what do you mean it's closed? I know perfectly well that it's safe. So I went through' (I3). Digital tools that can provide information about path closures offer valuable foresight and can help a lot in planning, but path closures can also impose constraints that don't always perfectly align with conditions on the ground.

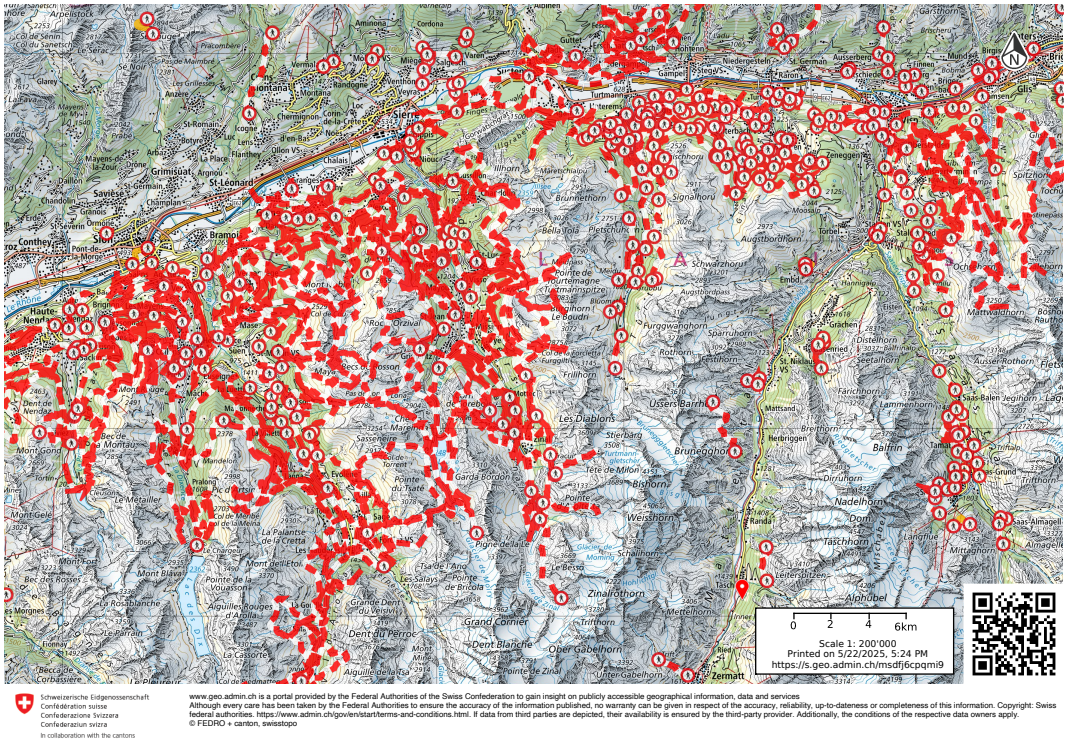


*Figure 21: Map of the Valais with footpath closures. Mostly following the late snow of April 17th, 2025 which caused great damage to trees and resulting in many path closures. (Swisstopo, last accessed 22.05.2025)*

### 3.2.6 Increased Frequentation in the Mountains

While widely discussed across the sample, a few mountain leaders pointed to the increasing human presence in the mountains as an emerging issue. Though not necessarily directly attributed to climate change, this rise in numbers can have tangible effects both directly on the mountain environment as well as the experience of working within it. One mountain leader reflects on the dual impact: ‘with climate change, with the human impact not only on the weather but also this huge influx of people on certain mountain trails [...] we are increasing the facts by erosion of the step, this is not new. Trails are the basis of erosion’ (I3). Another respondent highlights that ‘the number of people in the mountains’, linking it directly to increased ‘noise’ (S37), suggesting that crowding and resulting noise are becoming more noticeable and potentially disruptive. However, these observations were not widely echoed by other participants, and the comments remained relatively underdeveloped, making it difficult to draw firm conclusions about the broader implications for mountain leaders’ work.

While the link to climate change may be indirect, and could be explained in part by rising temperatures leading people to find cooler temperatures at altitude, such observations underline yet another pressure now shaping the mountain landscape and the profession of those who work within it. On the other hand, it does offer an opportunity for mountain leaders by creating potential future clients (as will be developed later (see section 3.3.10 Opportunities).

## 3.3 ADAPTATION STRATEGIES

Mountain leaders employ a range of adaptation strategies in response to the impacts of climate change (Figure 22). A first area of change is the planning and reconnaissance phase, which many report now requires significantly more time and attention. This preparation often leads to adaptations in timing, spatial substitution, or shifts in the type of activities offered. On the ground, mountain leaders describe being more attentive to changing conditions and taking increased safety precautions. Seasonal differences in adaptation strategies are also explored. In addition, mountain leaders often view themselves as having a broader role to play in responding to climate change, by reducing their own carbon footprint and by raising awareness among clients. Finally, this section addresses perceived opportunities emerging from environmental change, and concludes with reflections on how training has, or has not, supported mountain leaders in developing a solid understanding of the impacts and effective adaptation strategies related to climate change.

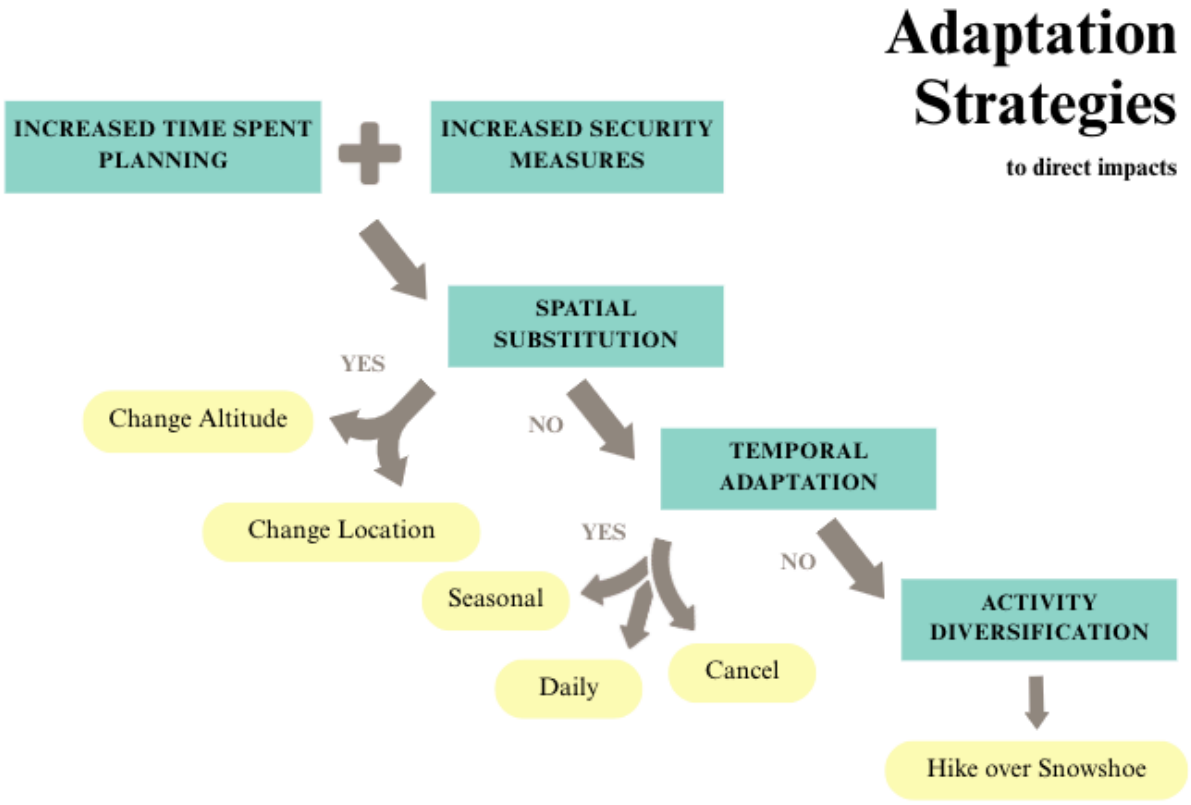


*Figure 22: Proposal of a decision flowchart of adaptation strategies used by mountain leaders to adapt to the impacts of climate change.*

### 3.3.1 Increased Time Spent Planning

#### 3.3.1.1 Increased Attention to Weather During Planning

A key part of the increased planning time reported by mountain leaders concerns the weather. Many describe spending significantly more time analysing weather forecasts, even for outings in areas previously considered low-risk. As one explains, 'What I have to do is to look at the weather and if there is a warning, I have to pay attention to it' (I1). Another notes that 'the biggest change for me is really to pay attention to the weather and to read the weather report as if I were in the [high] mountains' (I1), underlining a shift toward more careful planning even for outings at lower altitudes. This mountain leader mentions the importance of ‘keep[ing] an eye on the weather warnings, even for outings in the lowlands’ (S8). Others highlight how the importance of gathering information from multiple sources, both digital and local: 'The only thing we look at more is the weather... we ask the people who live in these places, we take as much information as possible and we have instruments [like] the app, SwissMétéo, which are very good' (I5). These detailed observations, often carried out days in advance, are central to ensuring group safety and planning alternative routes (more later): 'Then I have to plan the whole route... I have a plan B, plan C... it's very important to check […] into the avalanche protocol days before and on the day itself' (I6). In short, mountain leaders describe needing to 'be more cautious of the weather' (S25), engage in 'better weather management' (S49), and practice 'more precise observation of weather' (S78). As winter conditions become increasingly unpredictable, many stress the importance of 'extensive situation analyses' (S58) and 'targeted selection of locations and spontaneous planning' (S78) based on evolving weather dynamics. To summarize, as storms and extreme weather events become more frequent and hazardous, mountain leaders adapt by investing more time and effort to anticipate and navigate the weather conditions in advance.

#### 3.3.1.2 Increased Attention to Location and Itinerary

A second important dimension of increased planning time involves more detailed attention to location – both in terms of the broader region and the specific itinerary. As one mountain leader puts it, there is now a need for ‘special attention to the planning of hikes’ (S32), a shift driven in large part by increasingly unstable weather and landscape conditions, ultimately linked to climate change. The impacts of climate change ‘creates a lot more work for us and requires more flexibility on the ground. First in planning, then on the ground.’ (I2). In this sense, early in the planning phase, mountain leaders assess the suitability of a region by factoring in known risk zones and checking up-to-date information on trail status and weather forecasts. Tools such as SwissTopo and SwissMobility are seen as valuable resources in this process, allowing leaders to verify trail access in advance: ‘you can see on

SwissMobility that it's shut' (I1). This is particularly helpful in unfamiliar regions: 'What I already find very useful is that the SwissMaps site... indicated closed routes. So that's already a big advantage when you're going to regions you don't necessarily know', so as not to end up on the ground with a group of clients in front of a closed path and not know where to go (I2).

Once a general area is selected, greater attention is paid to **route-specific details** that take into account increasingly frequent climate-related impacts. Rising temperatures, for instance, shape decisions about route choice, timing and exposure. One mountain leader explains that because of the heat when hiking in summer, 'Yes, you need to be under cover, which means being in the forest in the early afternoon' (I7), which shows the additional time required to choose an appropriate route. Another explains the need for 'more detailed planning and greater observation and attention during the hike. Careful choice of locations for breaks for safety reasons.' (S30) Increasing rockfall and landslides, and the resulting path closures, require mountain leaders to pay attention to the state of the route as well as take into account the increased risk when choosing places to take a break.

Several mountain leaders point to the **increasing need for reconnaissance outings** to check terrain conditions, which have become more variable due to more intense rainfall and slope instability: 'doing a recce is important' (I1), especially 'due to landslides' (S47). It is 'during the preparation phase, [that] you can see whether you can bypass or have to change the area'(S81), which is far better than discovering on the day itself and it being too late to find an appropriate plan of action. However, these detailed assessments significantly increase the time spent in the planning phase. As one mountain leader puts it, 'it's a parameter that has to be taken into account from the outset and requires a good deal of flexibility in the field, but that's part of our profession. Sometimes you have to look for other routes, which is a bit more time-consuming' (S30). This growing complexity means that safe planning is increasingly time-consuming, yet is essential for mountain leaders to adapt well to the effects of climate change.

#### 3.3.1.3 Timing Phenology

When it comes to walks themed on the flora and fauna, the right location and timing within the season is of the essence to ensure that the outing is successful. Similarly to the need to increase time planning about weather and location generally, themed hikes need specific extra planning, as changes in seasonality can have important effects on phenology. As one mountain leader puts it, 'I adapt to how the season is' (I1), underlining having to make the shift from a relatively fixed seasonal calendar to a more reactive, observation-based approach. Along a similar line, another respondent states that they can 'no longer rely on a set calendar but observe what's happening on the ground' (S26). It is important to realise that to do this requires physically scouting out areas beforehand to see what is actually blooming,

what stage the vegetation is in or how animals are behaving. That means investing more time ahead of each outing to check on conditions that in the past were simply assumed.

This need for recces becomes especially important when fixed dates are involved. As one mountain leader explains in relation to botanical excursions: ‘Normally, we set the date, we cannot change that. But I will… probably invest more time to go and explore the trip. Otherwise, I would maybe have said “Oh, I know what’s there. I don’t need to go there on purpose a week ahead”’ (I8). In previous years, relying on local knowledge and seasonal regularity might have been sufficient. Now, with snow melting weeks earlier or later than usual, and flowering times shifting unpredictably, mountain leaders are forced to go and verify for themselves if they wish to do certain themed outings. The decrease of a stable seasonal rhythm increases uncertainty and adds substantial time to the preparation process.

#### 3.3.1.4 Communicating Between Actors

During the planning phase, there is also an element of communication between different actors in the mountain world which is both very helpful and enriching, while at the same time being time-consuming. Mountain leaders emphasize the growing importance of a horizontal and community-based approach to information sharing: 'It's also about sharing equipment, it's about having a much more horizontal and community-based approach to sharing information about changes in particular landscapes, valleys and so on' (I7). As climate change increasingly changes the working environment of mountain professionals, being able to gather first-hand, recent observations from others is invaluable for ensuring safety and making informed decisions about routes and conditions. However, building and maintaining these networks demands time and effort, particularly as communication infrastructures are still developing: 'Yes, and for everyone to be on the same wavelength and for information to be shared, information about danger, information about what's happening in the terrain, etc. But we're still a long way from that' (I7). As yet there is no centralised system for sharing up-to-date information, and mountain leaders have to gather from multiple different sources, be it social media groups, hiking websites, or by calling people on the ground such as hut guardians. However, relying on individuals in this way can feel like you’re burdening them, as one interviewee reflected: 'What could be helpful, especially if there were regional information sources. Often, if you go really into the high mountains, you would call up the mountain hut and maybe ask them. But I always have the impression you're taking away their precious time and I'm not super happy to use them as information sources. [...] That thing, I think, would be super cool if there were like an official, like a network of willing people [...] but you cannot talk to people' (I8). This mountain leader is imagining a system where locals (and other professionals) willingly provide information on local conditions.

**Digital platforms** are indeed playing an increasingly important role in facilitating knowledge exchange. As one mountain leader points out, 'it's helpful to have, like in the German-speaking part the Gipfelbuch, or Hiker.org, where you can look up recent reports of people that have been in an area. And the homepage of [...] Wanderland is quite helpful' (I8). These online resources allow mountain leaders to access recent reports and updates, either by other hikers or by official reports such as for path closures, offering a valuable supplement to personal reconnaissance. Yet even when these tools are available, staying up to date and verifying information still requires significant additional time and attention. In the context of an increasingly unpredictable working environment, knowledge sharing becomes not just a useful practice but a necessary one, albeit at the cost of greater planning demands.

## 3.3.2 Spatial Substitution

The most often raised adaptation mountain leaders are making to the impacts of climate change on their profession is the concept of spatial substitution, either by changing regions completely, or by modifying the route on the ground, whilst always ensuring having a plan B.

### 3.3.2.1 Changing Locations

While the need for flexibility has always been part of the profession, the increasingly unpredictable environmental conditions have made changes of route or region more frequent, necessary, and sometimes logistically complex. While mountain leaders have always had to monitor both their groups and the general environment, they now face a much greater need to constantly track specific risks such as heatwaves, path closures, storms, and snow cover loss. The ability to rapidly find and shift to alternative areas or routes has become a crucial skill, one that demands constant vigilance, advanced planning, increased local knowledge, and ultimately flexibility: ‘I would say in terms of changing locations, you need a bit of flexibility. Flexibility is linked to practice. For me, it doesn't add a problem, it's basic practice.’ (I3)

A major reason for changing location is the need to **react to the risks for immediate safety**, as well as find alternatives in the case of path closure. Mountain leaders sometimes have to react swiftly to avoid dangerous terrain, such as in the risk of flooding. As one leader recalled, ‘I changed my plans last minute because we were going by a riverside and well it was quite dangerous’ (I1). Such situations demand fast and informed decision-making, and require a lot of thinking to come up with satisfactory alternatives, though some mountain leaders don’t see this as too much of a problem: ‘The impact is very minimal. We make a detour. It's not a big deal.’ (7) In other cases, however, entire routes have had to be readjusted due to natural hazards and the resulting closure, such as the renowned Europaweg in Zermatt, which was closed because of landslide activity (I5), or as another respondent explains: ‘Last

year, for example, I had to cancel the Val Bavona tour and choose a different area instead.' (S101) Even when routes remain open, mountain leaders must also remain constantly vigilant for localized risks which still pose dangers to individuals and the group. One respondent explains that 'there's the danger of falling rocks: I stay as far away from the cliffs as possible' (S16). As for increasing temperatures, one solution is to adapt the route so as to 'find the cool higher up, or shade lower down' (S84). Mountain leaders must continuously monitor the environment during a hike, adjusting the route or break locations as needed to maintain group safety, but adapting the location can help to not feel financial repercussion of these challenges: 'I have always been able to avoid such danger zones and have never had to cancel a tour.' (S68) The increasing instability of the terrain requires constant assessment and adaptation, often leading to changes in the original plans to ensure both the group's safety and the execution of a successful trip.

Beyond immediate safety and closure issues**, changing seasonal and weather conditions** also strongly influence decisions about location. It is no longer sufficient to rely on traditional seasonal expectations or to take predictable weather for granted, but hikes must be planned with the unexpected in mind, with the possibility of changing locations and the flexibility to do that. One leader explained that 'usually, when you plan a hike or a multi day hike, either you do it in all weather, or if that is not possible, in the case of the Binntal for example, you change regions' (I2). If the weather conditions will make a certain route impassable or just dangerous, it is of the essence to be able to change the location of an outing or tour so as to still be able to conduct it within the constraints of the weather for that day and be open to 'choose other regions according to the weather forecast' (S18). Flexibility has become indispensable in a highly unpredictable context: 'Sometimes we have to forego certain excursions because the weather is uncertain (risk of violent storms). But for the moment the financial impact is minimal because we offer an alternative location.' (S2). This respondent shows how the weather can have a great influence, sometimes even to cancelling outings, but how by being flexible to change the locations for the same day, solutions can be found to maintain work for mountain leaders despite the increasingly challenging circumstances. In a similar mindset, another interviewee shares their opinion: 'No, and I think as a mountain leader I have more possibilities to adjust. I can just walk in the Mittelland. I don't have to go to the mountains. So I have a lot more possibilities and I don't think if I stay flexible that I financially will become a problem because of the climate change or changing conditions.' (I4) This respondent goes on to explain how this is sometimes in contrast with the work of guides, showing the flexibility of the mountain leader profession as a strength: 'I think for like my boyfriend is mountain guide, so for him in summer, the classical alpinism is way more difficult than for me in summer, because I can just go outside and walk somewhere with my client.' (I4) At the core of mountain leadership is offering clients an experience in nature, which is not necessarily dependent on the summit at all costs. In this

sense, most mountain leaders stay positive about the financial impacts, as they can usually adapt the location and still offer a valuable experience for clients.

As for larger scale seasonal variations, in winter especially, **the presence or absence of snow now varies widely**, even in traditionally reliable areas. As one interviewee described when planning for the winter season, ‘I can just not say, is there already snow in December or not, but I'm planning with snow in December. And if there's not, yeah, I have to either go to higher altitudes or […] change and not go with snowshoes or something like that’ (I4). The unpredictability is so that it would be impossible to make a fixed plan, since one never knows what the conditions will actually be like at the time. Instead, mountain leaders assess nearer the time, and if there is no snow they consider going higher in altitude so as to find it, or changing locations, say to a shadier zone with more snow. In this sense some mountain leaders have developed fallback zones with consistently better snow conditions, as one interviewee explains: ‘At the end of the Val d'Hérens, for example, below the Dixens, there's a really great place where the snow grows as it's so cold. Even now, snowshoeing conditions there are still ‘good’ compared with many other places where there's no snow at all. So these are places where, if it's too dry on the south side, I say, well, we'll go there. And I've already done that. And as a result, it allows... It's not necessarily the same locations. That's true.’(I3). Their testimony shows the importance of knowing alternative locations, as well as the willingness to use them and to change the original plan. This doesn’t just apply to winter conditions, but also to the seasonality of animals, which also require spatial adaptation in order to observe, such as, for example, watching stags bellow. One respondent reports the need to ‘adapt the altitude at which you observe the deer. Climb higher.’ (S6), highlighting the adaptation required also for observing fauna.

However, moving to a different region is not always a simple matter, as spatial substitution can bring with it **considerable logistical challenges**. Leaders must often organize transportation, renegotiate accommodation, and sometimes absorb unexpected costs. One leader recalled a last-minute rerouting of a multi-day trip: ‘we had to change our plans because of this [path closure] […] So we had to change the accommodation to find a new place to stay, but fortunately that worked out. So we kind of revamped the whole trip. It was a three-day event, one week previously, on short notice, but it worked out.’ (I8) Replanning a multi-day trip just days before is a huge amount of work, which in this case ended well, but requires much additional investment from the side of the mountain leaders. Finding snow can also sometimes involve driving significant distances, as recounted by one interviewee: ‘they told me, you can go snowshoeing. I don't see snow. You have to go back, behind this and this, you can go there. Okay, I have to drive a car. That's no problem. I make it’ (I6). If working for a bureau or tourist office, the decisions of location may not even directly lie with the mountain leader. In these cases, they maybe have to follow decisions, even if it means increasing the transport times. Financial aspects sometimes

also come into play: ‘lift tickets [are] not always expendable to clients’ (S1), shares one mountain leader, highlighting how location changes can come at a cost, which may not always be absorbed by the clients. Sometimes recces are needed to check if a new path is passable (S86), again increasing the preparation time and workload, time that is not directly paid. Although some mountain leaders manage to adapt without significant financial impacts (S2, S68), others, such as the respondent above, acknowledge that such flexibility requires substantial background work that may not always be visible to clients. The survey revealed that mountain leaders who report frequently changing location generally perceive their adaptation as more difficult (Figures 23 & 24). This trend is visible in both summer and winter, though it is only statistically significant in winter. Specifically, those who report often changing locations find winter adaptation significantly more difficult than those who never change locations. However, as several testimonials highlight, changing location is often not a choice but a necessity for those facing unfavourable or unsafe conditions.

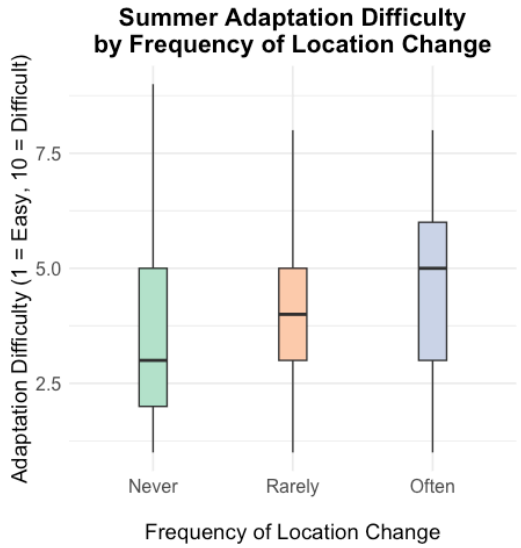


*Figure 14: Reported adaptation difficulty in summer by how frequently mountain leaders report changing locations.*

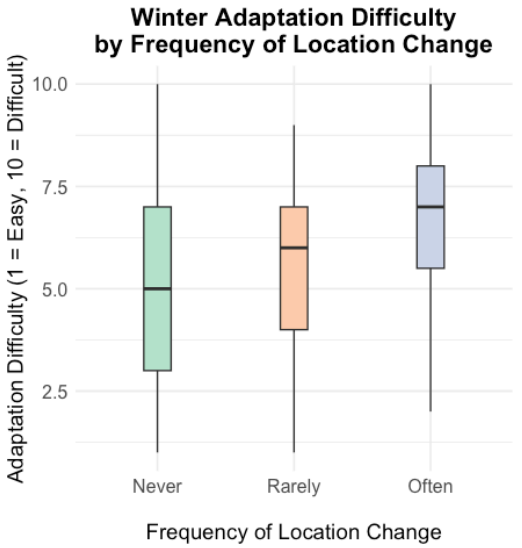


*Figure 24: Reported adaptation difficulty in winter by how frequently mountain leaders report changing locations.*

An additional layer of complexity is the necessity of **adapting** not only the hike itself but **also the client experience**. While mountain leaders are generally capable of adjusting to environmental conditions, clients are not always as adaptable. One guide highlighted this tension: ‘It's easy for professionals to adapt: all they have to do is adjust the timings and routes, but this isn't always accepted by customers…’ (S10). Clients are not always as aware of the different factors influencing timing and location, and therefore may not be as open to flexibility as those leading them: ‘Changes of location are not so easy to manage with customers who sometimes cancel because they don't want to go any further. So if there's no snow, there are fewer customers and more cancellations.’ (S6)

Another challenge can be increased **difficulty of alternative routes**. Changing to higher altitudes to find acceptable conditions, for example, might result in routes that are more physically demanding: ‘the hike has to climb higher in altitude and is therefore more difficult to access. Depending on the group, it's difficult to manage’ (S6); ‘Snowshoeing is not easy at higher altitudes, because the slopes are steeper (+30%) = more complicated planning and greater risk of avalanches.’ (S2). The planning aspect is also mentioned by another mountain leader who says that ‘The snow cover on many snowshoe itineraries is too uncertain, so we have to fall back on higher regions, which limits the choice.’ (S3). This shows that though it may be possible to go higher, depending on the area, there may be less route options. In this sense, all of these challenges show that the act of spatial substitution becomes not just a technical adjustment, but also a negotiation between professional realities and client expectations.

In conclusion, climate change has forced N increase in the practice of changing locations, though a basic of the professional toolkit, it is now one of the key strategies used by mountain leaders to adapt to the effects of climate change. This adaptation includes scouting out alternative locations, altering the route to ensure safety during travel, and adapt the region of their offers to the rapidly shifting and unpredictable conditions. However, these adaptations are neither entirely simple nor without cost: they require greater investment in planning (as mentioned above), logistical organization, and communication with clients.

#### 3.3.2.2 Always Having a Plan B

A central element of spatial adaptation mentioned by multiple mountain leaders is the necessity of always having a plan B. Many describe this as a basic professional skill, taught in their professional training: 'I think we are trained to adapt. We are trained on what to do if a path is closed' (I1). Having alternative routes or activities in mind has always been important for managing unexpected events, whether related to the group, weather, or terrain: 'Plan Bs, well, that's... We've always had them. So, in a... For any type of activity, plan B has to be there. It has to be in the back of your mind, because it's not just to do with climatic factors, but also to do with the people you have' (I3). However, with the impacts of climate change, such as more frequent path closures and unpredictable weather, this flexibility has become not just good practice but a necessary condition for working safely and successfully. This shift illustrates how climate change reinforces the need for constant alertness and the ability to adapt quickly to protect the safety and enjoyment of clients.

Mountain leaders explain how adapting routes on the ground is a regular part of their work, even if it is a basic skill: 'Yeah, I do adjust routes every time, but I think that's kind of the work we have to do' (I4). However some highlight that more extensive backup planning is now required than in the past, sometimes involving multiple alternatives: 'Then I have to plan the whole route with some different

things, with what I can do if I don't come through there. I have a plan B, plan C' (I6). In some cases, areas that once served as reliable backups have themselves become unsafe due to climate-related hazards, requiring even greater creativity and knowledge of the area: 'There are places where I used to go, even on the big tours, that were plan Bs, but they're no longer plan Bs, you can't go there any more. It's become too dangerous' (I3). This erosion of fallback options adds to the workload by demanding constant updating of personal knowledge about conditions in different areas as well as the flexibility to adapt spontaneously on the ground. Nevertheless, mountain leaders demonstrate resilience, emphasizing their ability to 'bounce back and find other alternatives' (I3), a skill that is now more crucial than ever in their professional toolkit.

On a more routine level, slight route changes or small detours are often easily managed without significant disruption: 'The impact is very minimal. We make a detour. It's not a big deal' (I7). However, even minor adjustments require careful prior assessment to ensure they are suitable for the group and conditions, especially given the growing unpredictability of the terrain as well as the weather. As one written response notes, 'Rain/storm plans for summer camps have become routine' (S38), illustrating how what was once an occasional precaution has now become a systematic part of planning. Ultimately, the constant necessity of contingency planning reflects the broader challenge climate change poses to the mountain leader profession, where change is the new normal, and flexibility is the key to maintaining both safety and quality experiences.

### 3.3.3 Temporal Adaptations

In addition to spatial substitution, another adaptation strategy used by mountain leaders to adapt the effects of climate change on their profession are temporal adaptations. This might mean changing the dates of certain excursions, altering the time of day at which it happens, or cancelling altogether.

#### 3.3.3.1 Seasonal Changes

One important form of temporal adaptation is the **strategic shifting of excursion dates** to better respond to the changes in seasonality. Since traditional seasonal patterns are becoming less reliable, mountain leaders are forced to rethink and reschedule the timing of their activities. Many have found it necessary to ‘postpone certain hikes to other months (not midsummer)’ (S80), or to ‘shift treks to the end of the summer season’ (S45) thus ‘extend[ing] summer into the off-season’ (S44). This strategy means moving excursions to periods where conditions are now more favourable, being less hot and the weather more predictable. This is mountain leaders’ way of adapting to the new realities of hotter summers and increasingly extreme weather events. Rather than cancelling trips outright, many mountain leaders prefer adjusting the calendar compared to what was done in the past. However, adapting the calendar is

not always straightforward. One mountain leader noted that ‘November/December is often more favourable for snowshoe hikes than January/February [so] snowshoe hikes take place in the last few months of the year’, but added that ‘the last few months of the year are not the time when people are most available for treks or snowshoe hikes...’ (S44). This illustrates how even well-judged adaptations may clash with client availability or holiday rhythms, highlighting the challenge of adapting not just to nature’s shifting rhythms, but also to relatively fixed social calendars.

Alongside these broader shifts, there is also a need to **respond to more immediate weather-related changes**. One guide explained that it is often necessary to ‘move the date of some of the tours according to the weather forecast’ (S18), highlighting how short-term extreme weather events, such as storms, heavy rain, or heatwaves, can disrupt plans even within an already adjusted season.

The need to modify dates is especially pronounced when it comes to themed excursions that rely heavily on specific natural phenomena, such as plant blooming or animal behaviour. One respondent raises the need to ‘change the dates for themed walks’ (S19), as nature and its cycles aren’t as predictable as they used to be, or happen at slightly different times of year. In these cases, climate change driven changes in phenology have made it necessary to ‘set dates differently, e.g. for plant excursions’ (S74), since blooming times are constantly changing. Activities once reliably organized around fixed seasonal markers now demand close observation of what is happening on the ground, and the ability to make last-minute adjustments. Mountain leaders need to observe what is going on in nature so as to ensure that the content of their excursion coincide with the right conditions, or else change the date so that the conditions coincide with the content.

#### 3.3.3.2 Adapt the Daily Schedule

In addition to adjusting dates at the scale of days or months, mountain leaders are increasingly required to adapt the daily schedule of their excursions in response to climate change. As summer temperatures rise and afternoon storms become more frequent, it has become common practice to modify departure times, rest periods, and the overall pacing of hikes. As one guide put it, ‘In summer, you might have to leave a little earlier, take a break in the afternoon’ (I7), an adaptation echoed by others who stress the importance of scheduling around weather risk. One respondent summarised this well: ‘Set off in the cool (earlier) on hot days. Plan to take breaks in the shade, and to walk in the shade during the hours when the sun is strongest. Adjust the timing to pass gullies or passes and ridges before thunderstorms, etc.’ (S10). These changes are important to avoid the hottest part of the day, which helps reduce the risk of heat stroke and fatigue. They also ensure that groups are not caught in dangerous places like mountain tops or ridges during increasingly frequent and violent summer afternoon thunderstorms. Another issue raised is that of river crossings, which one respondent commented that ‘Some stream crossings are only

possible in the morning' (S86), probably inferring that later on in the heat the melt water causes high water levels, though it could also be linked, as above, to the risk of flash flooding due to storm activity.

Although changes such as 'if it's very hot, you shift your timetable, etc...' might be seen by some as 'still common sense…' (S44), the frequency and consistency with which these micro-adaptations must now be made show that it is one of the key adaptation strategies used by mountain leaders to adapt to the impacts of climate change. Where once a standard schedule could be repeated across many outings, leaders must now consider how each day's forecast and terrain-specific risks shape the safest and most feasible itinerary.

#### 3.3.3.3 Cancel Activities

In cases where spatial and temporal adaptations are not suitable, it is possible that mountain leaders, or their clients, cancel the planned trip. There are very mixed feelings about this though, with some doing all they can not to cancel, as this mostly means a loss of income. One interviewee put it simply: 'I don't cancel. I don't cancel because... I mean, I really try not to cancel' (I3). For those, such as this mountain leader, whose livelihood relies on the days worked in the mountains, cancelling simply means no income, so finding alternatives is almost always preferable. However, others still take the decision, if reluctantly, based on their risk assessment: 'I've seen the days before, it's come rain and thunders and so on. No, we don't go' (I6). If safety is at stake, and other changes aren't possible, cancelling remains a responsible choice, but it is not without consequence. This interviewee goes on to explain the financial aspect of cancelling, saying that the clients 'No, they don't pay, no. For me also, when I do private, then of course I want to keep the clients. I don't say, hey, you have to pay me for that' (I6). This shows the delicate balance of wanting to keep clients whilst minimising losses. For group activities, the decision can also come from the client's side: 'In bad weather, it's easier for groups to cancel…' (S34), showing the reluctance to do outdoor activities in bad weather, even if this might objectively still be possible. While sometimes necessary, such as 'cancelling trips due to long periods of rain' (S36), these situations highlight how financial and practical pressures intersect with safety concerns, creating increasing challenges for mountain leaders.

### 3.3.4 Activity Diversification

Another strategy that mountain leaders use to manage the changes in their working environment is to diversify their activities. This can take two distinct forms: either diversifying within the scope of the job as a mountain leader, or diversifying their occupations outside of being a mountain leader.

#### 3.3.4.1 From Snowshoeing to Winter Hiking

One of the most pronounced forms of adaptation to climate change among mountain leaders is the substitution of winter activities, especially snowshoeing, with alternative offers such as hiking. However, as with other forms of adaptation, there is a spectrum of response. While some mountain leaders see no viable alternative to snowshoeing and express frustration or even resignation, others have developed creative responses. Even among the more proactive, however, substitution is rarely simple or without limitations.

A minority of mountain leaders see little to no room for adaptation when snowshoe conditions deteriorate. For them, snowshoeing is inherently tied to snow, and if snow is absent, the activity, and its economic value, simply disappears. As one interviewee put it bluntly: 'No snow, no snowshoe tours' (S81). Others echoed this sentiment with similar finality, stating that it is 'not possible to replace snowshoe outings' (S55), or that they can 'no longer offer snowshoe tours' (S96). Respondents with these perspectives tend to link the outcome directly to income loss, as well as reported difficulty in adapting to the changes in the winter season. One respondent noted: 'Fewer snowshoe tours = less income, I don't (yet) offer hikes in winter' (S101), pointing to the economic consequences of snow scarcity, whilst remaining open to the idea that in the future they may have to offer alternatives without snow shoes.

In contrast, many mountain leaders are actively attempting to **adapt by replacing snowshoeing with alternative winter activities, most commonly, hiking**. They recognise the changing reality of winter conditions and are attempting to modify their offer accordingly. In its simplest form, this might mean leading similar excursions on foot: 'So if there is no snow, we do it without snow. For me for now it is not too bad […] Well this winter we didn't have outings with snow... Well there are still other outings, just without snow' (I1). This person has taken the approach of keeping scheduled activities but just modifying the activity to accommodate the lack of snow. Another mentions having an alternative snow free plan from the get-go: stating the need for 'many more plan Bs without snowshoes to plan' (S14). One emphasised the relative ease of this substitution compared to other alpine disciplines: 'With snowshoes, compared to guides who are on skis, we have the advantage of being able to attach the snowshoes to our bags instead of having to carry all the equipment' (I2), highlighting a logistical flexibility that enables quicker adaptation.

This form of activity substitution is often framed as a shift from a narrowly defined snowshoeing product to a broader 'winter hiking' experience. Many respondents suggest the need to 'offer walks rather than snowshoe outings' (S23), or publicise 'outings on foot rather than on snowshoes' (S35), with the mindset that 'instead of snowshoeing, we go hiking' (S89). Others made more general remarks

about such a reorientation, such as the change towards ‘more hiking and less snowshoeing’ (S5), or simply that they ‘go winter hiking without snowshoes’ (S36). These reflect an emerging normal where snow is no longer guaranteed, and products must be reframed accordingly. In some cases, this rebranding extends to formal programming: ‘Drop some products, invent others, and rename some products so that they no longer refer to snowshoes’ (S43). Others spoke of needing to market a different experience altogether: ‘It’s a bit of a lottery when we draw up the outings programme and we can no longer promise snow, so we have to make people want to go without selling a “winter” activity’ (S22). The same respondent recounted a particularly stark example: ‘Last year we had to cancel the “Festiraquettes” because there was no snow at all in January – unheard of! So we need to rethink the concept’ (S22). This last quote really summarises what a lot of mountain leaders are both thinking and starting to do: an entire ‘rethinking of the concept’. Some mountain leaders are indeed moving beyond simple substitution to explore new types of products altogether. One suggested the need to ‘come up with ideas for other products to sell instead of snowshoes [and] we need to find customers who are keen on new products with less snow’ (S49), showing the need both for the product and a willing clientele. Another proposed shifting the focus entirely: ‘The solution is to change the theme of the outings from snowshoeing to winter in general’ (S6), which reflects a broader strategic shift, from adapting individual outings to rethinking the entire winter offer.

One of these new types of products might be the use of a **different type of equipment**, notably mini-crampons, which one respondent lists as one of their adaptation strategies: ‘[I] climb higher when possible, walk with small crampons instead of snowshoes, cancel snowshoe outings, travel to find (good) snow’ (S39). This is raised by another respondent who also suggests the possibility, ‘depending on altitude, [to] swap snowshoes for mini crampons’ (S54).

However, even those who are actively substituting report the limitations and trade-offs. Not all clients are willing to accept a different offer, and some respondents note that interest declines when snow is absent. One explained they ‘cancel outings or offer snowshoe-free tours, but people are less interested’ (S38), highlighting a decrease in desire on the side of the clients to modify activities. They add how ‘Snowshoeing on ice is not interesting, customers are not very interested in going out without snow in winter... customers wait to know the snow conditions before signing up (so last minute)’ (S38), showing how the thought of walking over snowshoeing is not ubiquitously welcomed, which is reflected in bookings and planning. Another explains how ‘snowshoe tours used to be a popular offer, but with less snow this tends to disappear’ (S87), suggesting a broader trend of demand loss and shifting public expectations. What is clear is that it is a mindset problem, as much on the end of the mountain leaders as that of the clients: ‘You have to remain very flexible and be prepared to walk instead of snowshoeing’ (S7), which is not always the case for either side of the equation. **Customer willingness to adapt** is

very important as it is directly correlated with mountain leader's profitability in winter (Figure 25). The less customers are willing to adapt, the more likely mountain leaders are to report having profitability in winter being negatively impacted.

In sum, while activity substitution is one of the most widespread strategies used by mountain leaders to deal with reduced snow reliability, it is rarely entirely straightforward. Some reject the possibility of hiking rather than snowshoeing altogether, while others actively reshape their products to maintain relevance and income. Yet even among the most adaptable, success depends not only on personal flexibility but also on client expectations and geography, so as to minimise financial implications.

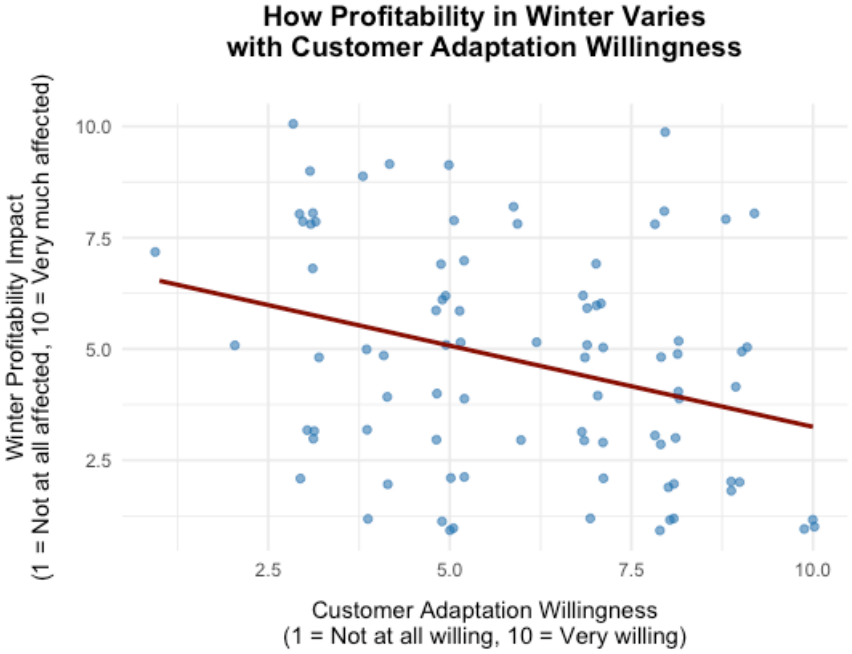


*Figure 25: The impact on mountain leader's profitability depending on customer willingness to adapt.*

### 3.3.4.2 Have Multiple Jobs

A more indirect way of adapting to the increasing challenges of offering and conducting winter activities is for mountain leaders to have multiple jobs, especially over the winter season, and to not rely solely (if at all) on their income as a mountain leader. For many, this diversification, while also reflecting longer-standing patterns of professional flexibility within the field, is increasingly used as an adaptation strategy to the effects of climate change on their profession and working environment.

Some mountain leaders view guiding as a complementary activity rather than a core source of income. These individuals typically maintain other primary employment and approach guiding as something

fulfilling, enjoyable, and part-time. One interviewee explained, ‘I worked 80% in a company in an office. And hiking guide was the second job, just for fun. Nice money to earn, but not essential... No, you don't count on it to earn your living’ (I6). Another reflected similarly, stating, ‘But to be honest, so far I have not relied on the revenues too much’ (I8). These comments show that for some, the need to adapt to decreasing snow cover predictability have minimal financial impact, because their livelihoods do not depend on their income as a mountain leader. As one participant put it, ‘My livelihood isn't really affected because I don't make 100% of my living from this activity’ (S25). In other cases, retirement plans reduce the need to pursue a full schedule in the mountains year-round: ‘As I'm close to retirement, the economic aspect is less important to me’ (S24).

However, not all mountain leaders are in this position. Many do depend on guiding income, and some have found it increasingly difficult to rely on winter activities alone, due to unpredictable snow conditions, shorter seasons, and increased cancellations. As a result, they have intentionally structured their work year to balance their work as a mountain leader in the summer with other types of employment during the winter months. One interviewee described this clearly: ‘So I have a second job. I'm an independent translator. So I decided that I reserve the winter for translation and I limit my activities to the summer season. For me, that was the solution’ (I2). Rather than getting frustrated and worried and having to constantly change plans and adapt, it was easier and more agreeable to simply forego leading groups in the winter months, and instead focus on a different income source for that part of the year. Another explained how, ‘Today, I focus much more on the summer period. Yes, it's more predictable, it's much easier to organise, quite simply. What's more, with snowshoes, you often have to go and hire equipment for your customers. It's much easier to just keep the summer season and then take a break for yourself during the winter’ (I7). They, too, see winter work as now unnecessarily complicated and unpredictable, and prefer to focus on the summer months. Since they refer to their mountain leader activity as ‘a secondary job’ (I7), it demonstrates their active choice to shift their main focus seasonally.

Such approaches highlight the increasing importance of pluriactivity in the profession. While some mountain leaders remain monoactive, relying solely on their guiding work throughout the year, the majority now combine it with other jobs or roles, particularly outside the winter season. Of the 104 respondents to the survey, only 15.4% reported being mono-active. The great majority therefore have another job alongside their work as a mountain leader. This diversification helps reduce dependency on an increasingly unreliable winter tourism model. As one participant put it succinctly, ‘It's a very interesting job. But maybe you shouldn't only do that’ (I5).

Taken together, these perspectives show how adaptation to the effects of climate change on the mountain leader profession can also consist of restructuring one’s professional life, even outside of

mountain leading work. For most mountain leaders, having a second job is not just a back-up but has become part of the professional norm.

### 3.3.5 Increased Security Measures

Larger scale adaptations such as location or temporal changes are a very good starting point, but on the ground adaptations are also needed to ensure group safety when facing increasingly extreme terrain and weather conditions. These measures include carrying more safety equipment, being more attentive to security on the hill, reduce the group size, and to carry more water in summer.

#### 3.3.5.1 Carry Safety Equipment

Though carrying basic safety equipment has always been a part of the mountain leader's role, the survey and interviews reported an increasing tendency to carry more safety equipment than before, and more frequently. As one interviewee put it plainly: 'We take more safety equipment... we take more instruments than we used to' (I5). Another expressed the need to 'adapt the equipment in your backpack, [and to] take a rope' (S40). A rope might be used by a mountain leader to help one or multiple clients over a slightly trickier part of terrain, or they might set up a handrail for a river or névé crossing. An ice axe, also only carried by the leader, is most often used to cut steps in hard snow at the start of the summer season, such as to cross a névé. Not only is more equipment being packed, it's also now more likely to be used. One interviewee reflected on how, in previous years, gear would often stay untouched in the backpack: 'For years, I didn't use any safety equipment.' But more recently, that's changed: 'At the end of the season when I'm sure, I'll do a tour of Mont Blanc without rope or ice axe. But right now, at the start of the season, I always take them... now, frankly, I've used them' (I3).

One interviewee suggested that wearing helmets during certain parts of a route should also become routine, with the increasing and unpredictable risk of rockfall. 'With these rock falls... not big events, but stones that fall spontaneously... I said to myself that for certain passages, we might have the helmet in our [bag]... Not for the whole day, but... it'll start to be common practice to wear a helmet' (I2). While not yet a broadly established norm, it shows how some mountain leaders are constantly assessing the evolving risk and how to best adapt to ensure the group's safety.

#### 3.3.5.2 Increased Attentiveness on the Hill

In addition to carrying the right safety equipment, mountain leaders also increasingly stress the need to sharpen their awareness and response to risks while out on the hill. This means not only knowing how to use the equipment properly, but being more attentive and proactive in decision-making and group management throughout the day.

One full-time mountain leader (I3), who therefore spends much of his time working year-round in the mountains, was especially vocal about the need for a collective step-up in safety standards. 'We need to move up a gear here,' he said. 'We shouldn't wait until we've had accidents with professionals before saying, shit, we didn't have the technical level.' He emphasised that safety training and preparation need to be more than a formality: 'I found myself doing courses to finish, it was to validate it, to get the stamp... And then I thought, fuck, the [security] level really isn't high!' For those leading longer or more exposed routes, he was clear: 'It would be a good idea to be a little more rigorous in terms of safety.'

This call for heightened vigilance is echoed by others, who point to changes in how they manage groups and choose terrain. One mentioned making 'more detailed planning and greater observation and attention during the hike,' including carefully choosing spots for breaks with safety in mind (S30). Others mentioned the need to 'be more careful when crossing exposed areas' (S31), and to 'be much more careful when passing underneath cliffs…' (S71), pointing to the kinds of terrain that are becoming more unpredictable as rockfall increases.

Together, these testimonies suggest that the evolving mountain environment requires greater attentiveness to risk, with safety equipment and group management choices playing an increasingly important role, making safety precautions and risk awareness a more integral part of everyday practice.

#### 3.3.5.3 Reduced Group Size

Another choice that can be made in the planning phase is to decrease the group size in order to ensure better safety supervision. As conditions become less predictable, some mountain leaders are proactively limiting group sizes to maintain closer oversight. One respondent described taking ‘increased caution, [with a] maximum number of participants reduced as a safety measure’ (S9), indicating that smaller groups are seen as a practical way to better manage risks. Another noted, ‘I work in small groups (1–4 guests). This gives me a clear overview and I can look after each individual guest’ (S66), highlighting how a smaller leader to client ratio can enhance safety and allow for better client care during the outing.

#### 3.3.5.4 Carry more Water in Summer

Another concrete adaptation to increasingly hot and dry summer conditions in the mountains is the need to carry more water. As reliable water sources become less predictable as temperatures increase, mountain leaders have had to plan accordingly to ensure their groups stay hydrated and safe. In especially dry summers, coordination between groups becomes valuable: 'The [WhatsApp] group is super important. Typically, two or three fountains were passed… the first [mountain leader] of the day to pass would say, it's OK, [the source] is flowing today. That way, the others know that we can load less water at the bottom. Otherwise, we load a lot of water at the bottom, we have heavy bags, we have

people who can't take it anymore, so they drink even more, so they still have more water. Hence the filter. But I've also found dry torrents, in places where I expected to have water and then there wasn't any… More water, more water, more water' (I3). This interviewee explains how he also now carries a water filter with him when leading groups: 'So we're on high routes, walking all day. What's changed for me, for example, is that I now carry a water filter with me. A little Katadyn, a simple thing. I can filter water all the time' (I3). This means that they are able to refill water whenever they come across it, and thereby diversify their potential water sources.

Overall, though, 'the impact is to have enough to drink' (I7), which often simply means the need to 'carry more water' (S33), which requires foresight as well as increasing pack weight.

### 3.3.6 Seasonal Differences

The survey reveals clear seasonal differences in how mountain leaders experience the need to adapt to climate change and its effect on profitability (Figure 16). A Kruskal-Wallis test showed statistically significant differences in profitability across levels of adaptation difficulty in both summer ($\chi^2 = 24.18$, df = 9, p = 0.004) and winter ($\chi^2 = 46.53$, df = 10, p < 0.001), with the relationship being stronger in winter. In both seasons, those reporting greater difficulty adapting also reported lower profitability. Post-hoc Dunn's tests (Bonferroni-corrected) confirmed this trend, particularly in winter where contrasts between low and high difficulty levels were more pronounced. In summer, the association was present but weaker.

Figure 26 illustrates these patterns: most mountain leaders report moderate adaptation needs and moderate financial impacts in summer. In winter, both adaptation demands and profitability loss are more severe, with a wider range of experiences, including extreme cases. Overall, adaptation difficulty is significantly linked to reduced profitability, especially during the winter season.

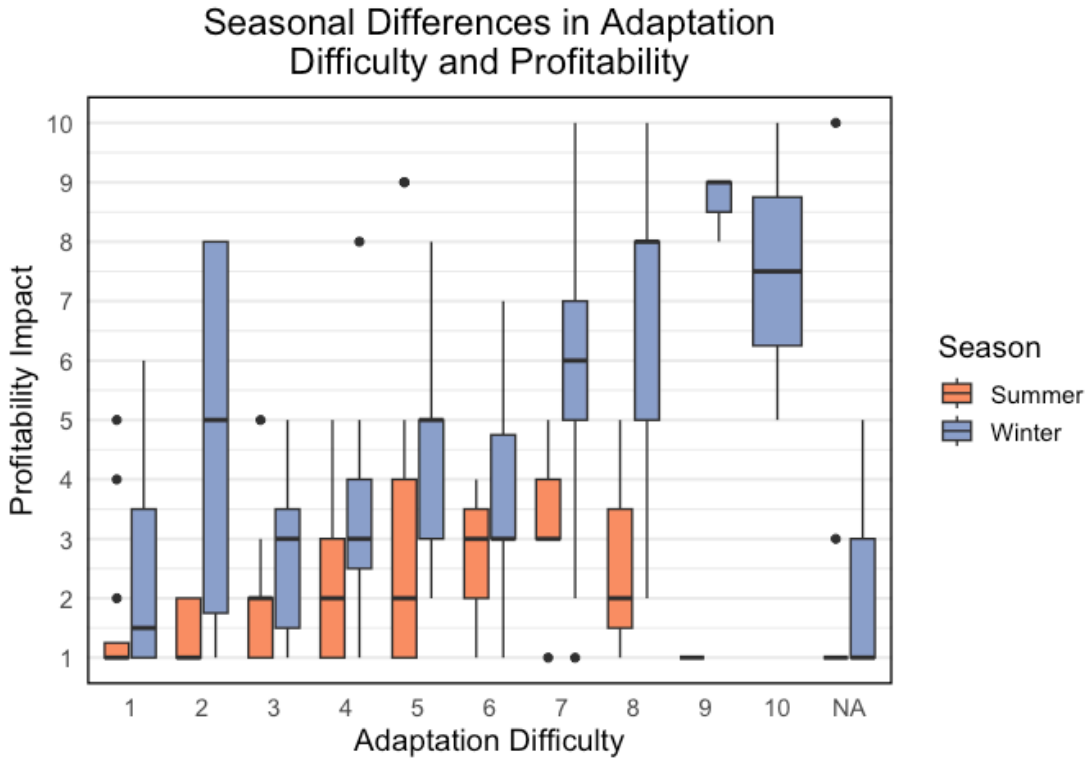


*Figure 26: Seasonal Differences in Adaptation Difficulty and Profitability*

This study explored whether mountain leaders' experience level has an influence on adaptation. To statistically test whether experience level or the number of days worked had a significant effect on perceived profitability, a Kruskal-Wallis rank sum test was used. In both cases and for both summer and winter, the results indicated no statistically significant difference in profitability impact across groups. The results are shown in Figure 27, which shows there is no visible correlation between adaptation difficulty and years of experience. However, the graphs do show that no matter the experience level, adaptation in winter is more difficult in summer, which aligns with what is described above. NA refers to those who didn't answer this question, usually because they don't think that they need to adapt their practice during the season.

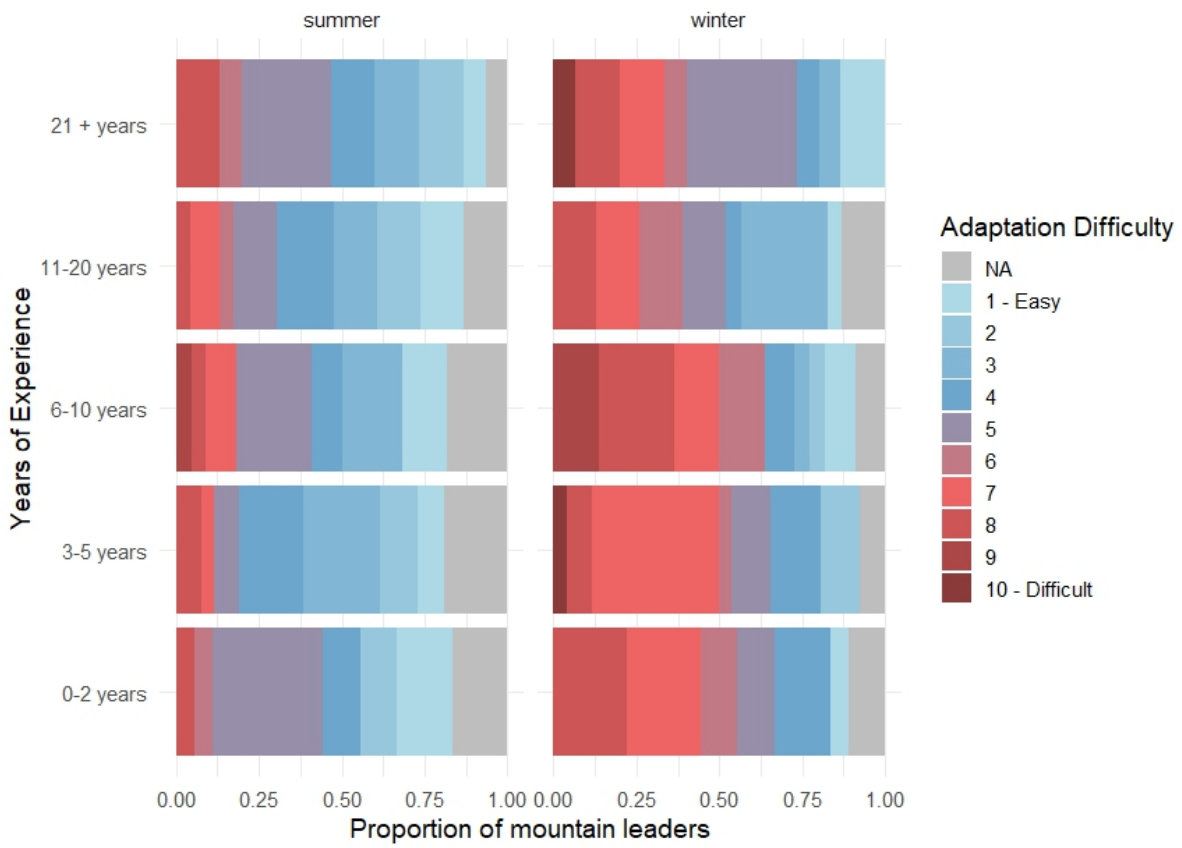


*Figure 27: Years of Experience and Adaptation Difficulty depending on the Season*

Despite the lack of a statistically significant result, there is a clear visual trend suggesting that mountain leaders who work more than 150 days per year experience a higher impact on profitability. This is likely related to their stronger financial dependence on their guiding work. As shown in Figure 28, those in this group report noticeably higher impacts on profitability compared to those working fewer days. This

pattern appears in both seasons, but is especially pronounced in winter, where they represent the largest share of individuals reporting high levels of profitability impact.

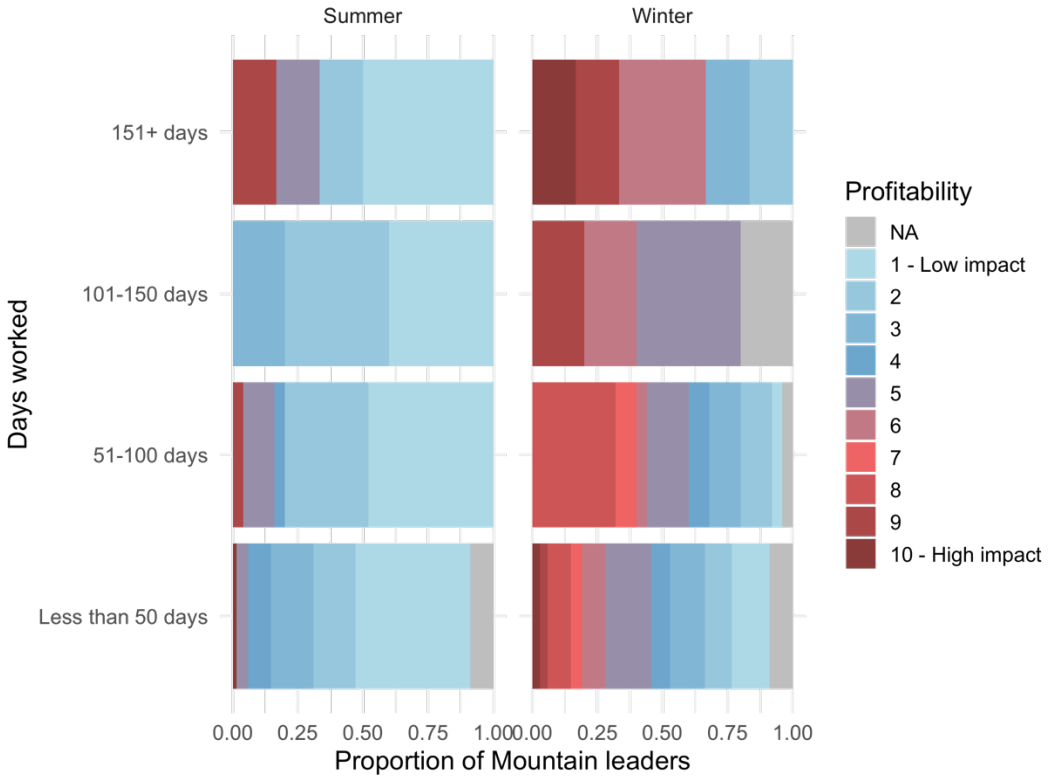


*Figure 28: Impact Levels of Profitability by Categories of Days Worked, depending on the Season*

### 3.3.7 Regional Differences

Another interesting aspect of adaptation in the mountain leader profession is how it varies across regions and altitudes.

Figure 29 shows us how adaptation strategies are distributed depending on the altitude that mountain leaders reported most frequently working at. A chi-squared test was carried but no statistically significant relationship was found between altitude and the use of any adaptation strategy. However, there are still visible trends, such as how activity substitution (in the case of these statistics, only hiking rather than snowshoeing was considered, and not having multiple jobs) seems to be used more at lower altitudes rather than higher altitudes. Other strategies such as increased planning, security measures and temporal adaptations tend to increase with altitude. Spatial substitutions tend to happen across the board,

though this doesn't differentiate between staying in the same region and simply going higher or lower in altitude, or changing regions or route altogether.

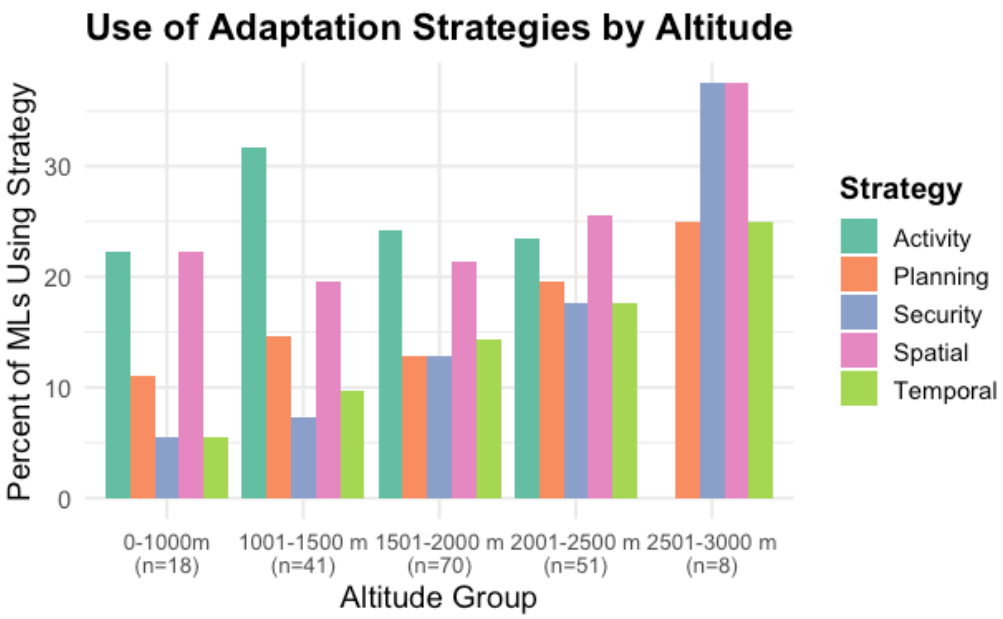


*Figure 29: How mountain leaders report using the different adaptation strategies depending at what altitude they work at.*

The maps of Figure 30 illustrate how adaptation strategies vary by region. A series of Chi-squared tests were conducted to assess whether the use of adaptation strategies is associated with working in specific regions of Switzerland. The only statistically significant relationship was found between working in the Prealps and the use of activity diversification ($\chi^2 = 4.87$, $p = 0.027$). A marginal trend was also observed for spatial substitution in the Prealps ($p = 0.058$). No other statistically significant associations were found between strategy use and region.

Nonetheless, some patterns are worth noting. Regions such as the Jura and Central Switzerland show relatively high rates of activity diversification compared to areas like the Valais or Eastern Switzerland. Security measures are proportionally most reported in the Valais. Spatial substitutions, in addition to being frequent in the Prealps, are also common in the Berneroberland and Eastern Switzerland, but less so in the Jura and Valais. Interestingly, respondents working in the Valais report using all strategies at relatively similar levels, whereas those in the Prealps and Eastern Switzerland rely more heavily on spatial and activity-related adaptations.

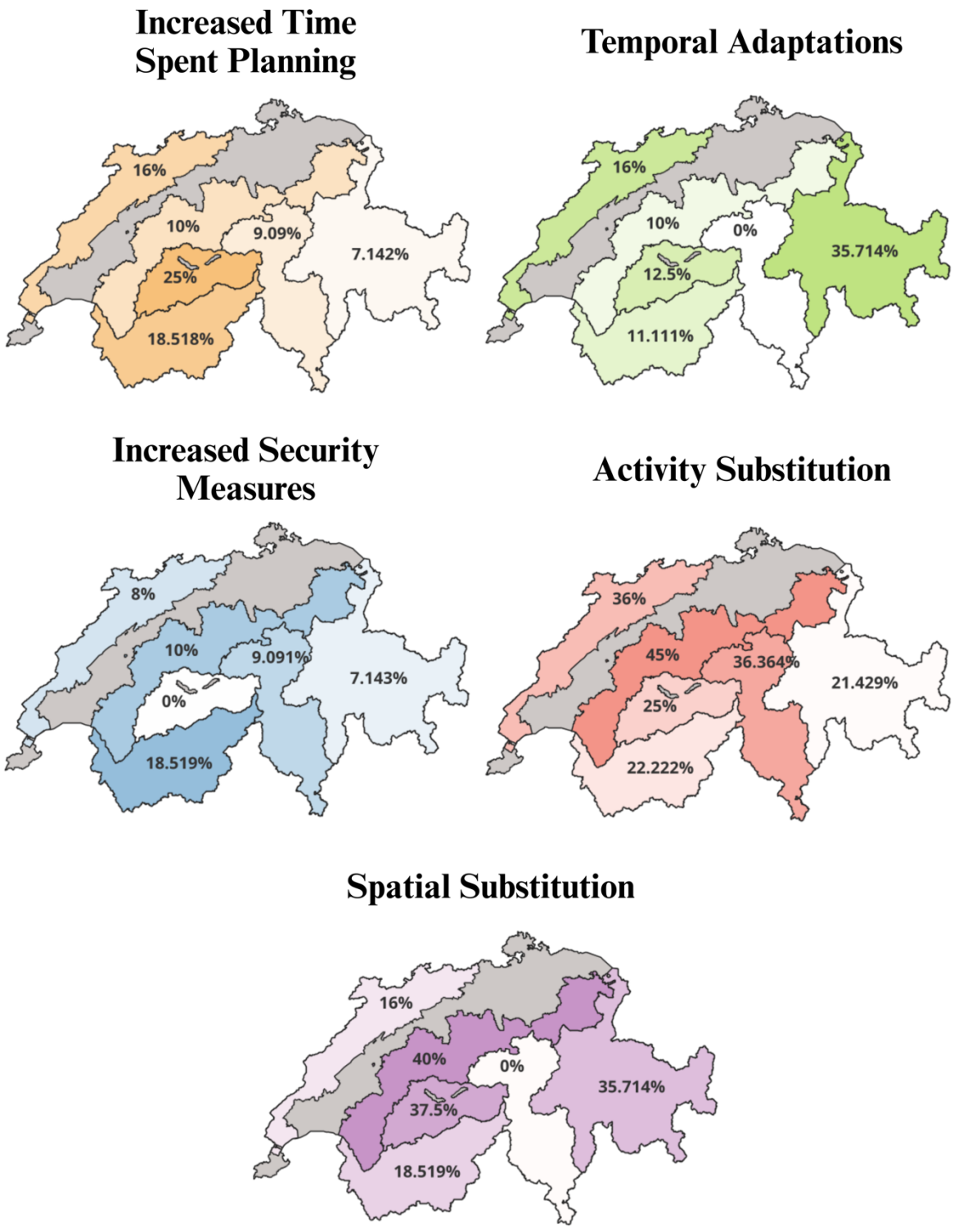


*Figure 30: How mountain leaders report using the different adaptation strategies depending on which region they work in.*

### 3.3.8 Personal Environmental Impact of the Mountain Leader

An element regularly raised throughout the survey and interviews was the ways in which mountain leaders, through the way they operate, can reduce their impact on the environment, as well as educate their clients on climate change. In terms of reducing personal impact, strategies mentioned included prioritising the use of public transportation over personal car use, being less consumerist in the area of clothing and equipment, and staying in simpler mountain huts. Education of clients took differing forms, from official workshops to themed outings or relaxed chats about why a path is closed.

#### 3.3.8.1 Use of Public Transportation

Among the most frequently mentioned strategies for reducing personal environmental impact was the **prioritisation of public transportation**. Many mountain leaders not only try to limit their own use of private cars, but actively encourage their clients to do the same, by directly building it into the logistics of a tour: 'Almost all my tours are accessible by public transport and I strongly encourage my clients to travel by train/bus' (S9); 'My tours only take place by public transport' (S82); 'Go hiking only by public transport' (S29); 'I always take public transport on all my walks. We don't use private cars' (I7), or 'All my outings are by public transport' (S30). This might mean, as one mountain leader explained, taking care to align start and end points with local transport schedules: 'I also always, […] or almost always go with public transport. So do my clients, because I really organise, like the starting point goes with the timetable of the bus… My clients almost never come with their personal car' (I4).

This shift toward more sustainable travel is about modelling and explaining values as much as it is about logistics. Several leaders highlighted their efforts to 'talk about the impact of travel' (S30) or to 'present examples' of climate-friendly practices like using 'mountain buses or alpine buses' (I8) and saying that 'We really need to encourage public transport' (I7). This happens not just at the individual level but sometimes at the level of the travel company: 'Our company makes a big effort to use public transport… we take the train, public transport. And I also try to explain why' (I2). This points to the educational side of explaining why they make this choice, so that clients end up with a better understanding and appreciation for less impactful travel.

When public transport is not available or practical, **car sharing** may be proposed as a compromise. A few mountain leaders mentioned this: 'But I try also, for example, to car share' (I1); 'When I go with the clients… going by car, but all in one, like that' (I6). This approach reduces the number of vehicles on the road and minimises emissions, particularly in more remote regions with limited public transport options.

Others take further steps, such as **avoiding long-distance travel or flights** entirely: ‘For me… it's very important… not to fly abroad. I don't even want to guide or to lead outside Switzerland’ (I4). Another states that they ‘avoid transport by car and plane’ and therefore encourage ‘gentle tourism’ (S33). However, there is also recognition that not all circumstances allow for such choices. One respondent explained, ‘I'm starting to encourage my private customers to carry their bags and use public transport (no unnecessary taxi trips). My foreign customers, on the other hand, can only come by plane (except possibly the UK)’ (S39). The first part touches on a practice common on long-distance routes such as the Haute Route or the Tour du Mont Blanc, where luggage is transported by taxi between accommodations to lighten hikers’ day packs. Here, the mountain leader points to the emissions generated by this added transport – emissions that could often be avoided if clients were to carry their own gear. Yet they also highlight a more complex issue: the carbon impact of international clients who must fly in to access the Alps. While these emissions are outside the direct control of the mountain leader, they nonetheless contribute to the footprint of the tours they lead. This underscores a broader tension: many mountain leaders aim to reduce their environmental impact, but must navigate market expectations and their own economic realities, including the engagement with international tourists and the expectations of clientele.

In summary, these examples show that promoting more sustainable mobility is both a matter of personal ethics as well as an integral part of how many mountain leaders plan, guide, and model in their work.

#### 3.3.8.2 Other Ways of Reducing One’s Carbon Footprint

While not widely mentioned, one mountain leader raised the issue of overconsumption of equipment and outdoor clothing as part of the broader environmental footprint of the profession. They reflected, ‘there was all the equipment consumed by mountain leaders. It’s absolutely not a question of feeling guilty, but of marking or having a closer look at the job we do’ (I7). They went on to stress the importance of using only what is necessary: ‘You need good equipment, safety equipment, but you need to have just what you need.’ From their perspective, the outdoor industry places a heavy emphasis on gear and promotes clothing purchases, often following patterns similar to fast fashion. In their view, not enough mountain leaders prioritise long-term use or mending of gear over replacing items – for example, repairing an old pair of trousers rather than buying a new pair.

This same critical lens extended to the infrastructure of mountain tourism, particularly the increasing comfort of mountain huts. ‘Cabins are becoming more and more... like very high quality hotels in the high mountains,’ they explained, ‘where you end up with five kinds of white wine, eight kinds of red wine, five kinds of beer, and more or less fresh salad. And it all works because there's a helicopter and

helicopters are cheap. Which also has an impact.' For them, a more sustainable approach to work as a mountain leader is to favour simpler huts that are less reliant on supplies by helicopter.

Altogether, this mountain leader advocates for a more 'virtuous' approach to the material side of the profession, one that consciously limits unnecessary consumption and favours simpler infrastructure, thus seeking to reduce overall environmental impact.

### 3.3.9 Raising Client Awareness About the Impacts of Climate Change

Many mountain leaders see it as part of their role to raise client awareness about the effects of climate change in the high mountains. Whether through conversation, demonstration, or structured learning, there are many different ways that the realities of climate change are brought into the experience of a hike.

One of the most common ways mountain leaders raise awareness is by **showing clients the visible signs** of climate change in the landscape. Glacier retreat is especially effective here, and many guides take time to point out where the glacier used to reach, sometimes using old maps or photos to make the change easier to see and understand. As one mountain leader explained, 'I have […] a book from earlier, pictures from earlier from Grindelwald with the glaciers or something, then that I might show them' (S6). Another similarly notes that 'On hikes with a view of glaciers, I show you where the glaciers were 10, 20, 30 years ago (with pictures) and you can see the difference' (S70). Changes in flora and fauna are also noted as helping to show evolutions, especially the appearance of new species, the rising of the tree line, and shifting vegetation zones, as one respondent notes raising awareness 'by showing examples of bioinductive plants, invasive plants, migration patterns, demographic influence, lack of quality water, etc.' (S15). These observations often take place directly on the hill, in response to something seen: 'By giving concrete examples when we come across them (debris flows, landslides, dying glaciers) and explaining the changes in vegetation levels linked to global warming and the impact on wildlife' (S19); 'By showing them the disappearance of glaciers. The agony of the trees' (S13). One respondent notes talking about the topic following the appearance of 'obvious signs, such as small landslides, undulating roads, lack of snow, hot weather, capricious weather' (S90). Leaders describe this as a way to anchor abstract issues in direct experience, as well as giving them a springboard to talk about the topic in a natural way, thus helping clients connect what they see during the hike to a globally discussed topic.

Alongside showing the immediate and visible changes, many leaders also focus on **explaining the processes**. For those with scientific or environmental backgrounds, this comes naturally: 'As a scientist, I deal with the consequences of climate change, and I bring my knowledge and my own results to the excursions' (S74); 'I am a geography teacher and often go hiking with school classes to show signs of

climate change in the landscape' (S79). One explains diving deeper into natural interconnectivity, by trying to 'explain the connections between the environment, the terrain and people' (S81). Several mountain leaders said they try to give clear and accessible explanations of the phenomena clients are observing: 'By trying to explain today's climate with that of the past' (S92); 'Explaining geological backgrounds, permafrost' (S86). One respondent summarises it well by saying they 'explain in words and show traces of them on site' (S95), showing that the aim is not just to point out landscape forms, but to help clients interpret what they encounter and to understand the links between what they see in the landscape or the weather they encounter within the larger context of climate change.

While some mountain leaders make climate change a central theme of their outings, others describe a **more responsive approach**, where conversations emerge informally. They do their best to engage in conversations in context, responding to clients' questions or spontaneous observations rather than leading with structured messaging. One explained that on longer trips, it's rare for the topic not to arise: 'it's not me who raises it, because I know it's going to come up sometime. Or I raise it indirectly, typically in relation to an itinerary, by saying that we won't be able to go that way any more… and bam, we've got it. It's a recurring question' (I3). In this way, the conversation is initiated by the clients, who are therefore directly interested. Another mountain leader reflected similarly: 'the subject is very often raised spontaneously, because if you look around you can see changes and that encourages discussion' (S47). In such cases where environmental change are visible directly through the landscape itself, clients' reflection is often prompted and discussions can open naturally. Others mention how by sharing their decision-making, they can involve clients in the reflection process, making it a lot more real and connected for them: 'I comment on my decisions, e.g. to bypass an area or draw attention to changes in the landscape' (I7), and 'I share my observations, start a conversation about it' (S71). These examples show an approach that allows the clients to be a part of the thinking process, and to involve them in questioning the processes behind the landscape they experience.

Multiple mountain leaders express a **desire to avoid moralising** or overwhelming clients when they speak about climate change. They describe the need to strike a balance between reality and tact, particularly when working with international groups. One noted the difficulty of addressing climate change directly while working with 'a group of Americans who have just got on a plane', stressing the importance of finding 'a way of doing it objectively' (I2). Another reflected on how some clients simply don't want to engage with the topic at all: 'I try to explain and show them the huge changes affecting our mountains. Unfortunately, they often don't want to see the reality and don't realise it or don't want to believe it' (S7). In response, many mountain leaders prefer to lead by example or speak through personal stories rather than offering overt critiques. 'I try to make them aware of the beauty and well-being that our environment gives us… without sounding moralistic', explained one respondent (S25).

The general consensus seems to be to raise awareness but ‘certainly not through moralising lectures’ (S3), as clients are usually primarily there for an enjoyable experience and not to be lectured at, as summarised by I7: ‘So, with customers, first of all we're there to enjoy the hike. We've got this itinerary, a priori the itinerary, there are no safety problems, I've checked beforehand, etc. If the subject [of climate change] comes up with the customers, we can talk about it.’ (I7)

While some guides wait for climate conversations to arise naturally, others take a more **structured approach** by organising themed walks or directly incorporating environmental education into the outing itself. One guide explained that they lead ‘theme hikes on the environment, climate change and sustainability’, making it a deliberate framework for discussion (S30). Another said they often use ‘games about altitude levels or similar’ to highlight shifting ecological patterns, especially with younger groups such as school classes (S62). Such interactive methods are seen as a way to both inform and engage in an intentional way: ‘Through explanations and activities’, one respondent noted, ‘I try to make people aware of what is happening’ (S43). Another mountain leader shares how they weave in more formal approaches into outings on other themes, since their clients are already very interested in nature and are therefore open to discussing systemic impacts: ‘Depending on the topics covered, this will come up, for example, for picking and flowering dates (you need to choose locations and altitudes accordingly). Or for outings on ibexes: how the start of spring influences the growth of the horns of young ibexes, and so on. Basically, it's a subject they've chosen and therefore care about, and showing them that this change has consequences at every level. I also raise awareness of lots of other things that are indirectly related (behaviour in the mountains, waste management, electricity production, consumption in general, etc.)’ (S22)

## 3.3.10 Opportunities

Though, on the whole, incomparable to the *negative* effects of climate change on the mountain leader profession, respondents from the survey, as well as interviewees, did raise a few possible opportunities that climate change can bring. These include glacial retreat creating increasing terrain within their remit, an increase in demand for professionally led hikes, as well as the possibility to sell new offers. While a demographic analysis was carried out to explore whether age, sex, or experience shaped perceptions of climate-related opportunities, the results did not reveal any clear or consistent patterns.

### 3.3.10.1 Increased Terrain

One of the few, and perhaps most obvious, upsides mentioned by mountain leaders in relation to climate change is the opening up of new terrain as glaciers retreat. As 13 mountain leaders note, there are increasing routes with the retreat of the glaciers. As glaciers are outside mountain leader’s remit, their

disappearance means it is now possible to walk where the ice once was, thus opening up the possibility of new routes. High altitude passes are also becoming ice free, offering other types of routes: 'peaks/cols that were previously inaccessible for hiking because they were covered in ice' (S24). This pattern shows that routes once reserved for high mountain guides are now, or will soon be, walkable terrain for mountain leaders, as the snow and ice cover recede. Another reflected that 'some hikes have become impossible (terminal tongue of the Glacier du Trient) [while] others have become possible (crossing the Schnidejoch)' (S24), as shown in Figure 31.

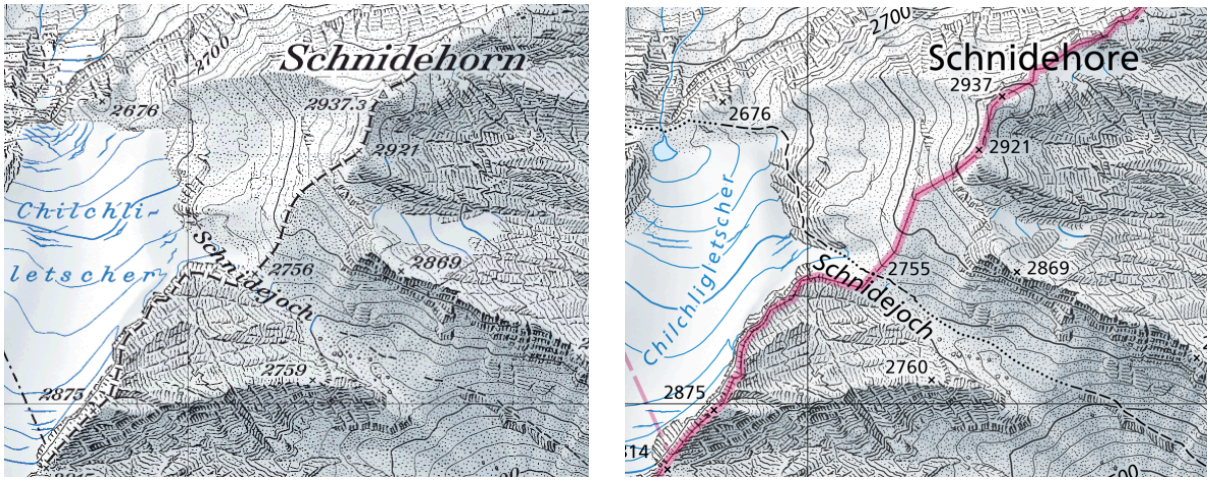


*Figure 31: Comparison between 2000 and 2021 at the Schnidejoch mountain pass, where the pass became accessible for hikes and within the remit of mountain leaders, due to the retreat of the Chilchli glacier (Swisstopo, 2025).*

Although not always directly related to glacier melt, a similar expansion of possibilities is occurring during the winter season, where one interviewee described how, in certain areas, 'we're clearly starting [our hikes] higher up. And then, at the top, you can go further. Which is something I couldn't do before' (I3), emphasizing the changing environment sometimes also offers new possibilities previously inaccessible.

While most respondents acknowledged that these new opportunities come at the 'sad' cost of the glaciers (S44), this expansion of accessible terrain remains one of the few relatively clear and consistent benefits mentioned in relation to a warming climate.

#### 3.3.10.2 Extended Summer Season

One of the more commonly mentioned opportunities linked to climate change is the potential extension of the summer hiking season (S12, S23, S52, S63, S87). As snow melts earlier and arrives later, many mountain leaders see the chance to guide over a longer part of the year, particularly in spring and autumn. The shoulder seasons are seen as increasingly viable: 'The shoulder season will become more

attractive' (S99), and with 'pleasant temperatures in spring and autumn' (S69), some outings that used to be limited to summer months can now be done earlier or later in the year.

However, this potential is often tempered by infrastructural limitations. For instance, one mountain leader notes the possibility to ‘extend the season in autumn’, but adds ‘in bivouac or mountain huts if they also remain open’ (S10), highlighting how longer treks require accommodation infrastructure to adapt alongside changing conditions. Another reflects that 'one can usually still hike until November. However, I think people are not so eager to hike during this time of year because it's rather cold, there are no more plants to see, the days are short, and often no trains run anymore...' (S82). This quote points to a dual limitation: not only does infrastructure such as public transport and huts often cease operating outside the traditional season, but client mindsets also remain tied to conventional ideas of when hiking is ‘appropriate’. In sum, while environmental conditions may now allow for a longer season, the broader tourism system, including services and client expectations, must evolve in parallel for this opportunity to be fully realised.

#### 3.3.10.3 Evolving Demand for Professional Supervision

One opportunity raised on multiple occasions is the idea that with the increasing unpredictability and risk of the mountain environment, more people may seek professional supervision rather than venturing out alone. One interviewee reflected: ‘people are […] less likely to go out on their own. They say no, I’d rather be supervised by a professional for my own safety’ (I2). Others echoed this shift in behaviour, suggesting that ‘given the instability, people may tend to hire a mountain leader more easily’ (S23), and that ‘more people will join a guided group for safety reasons’ (S98). Rather than stopping going to the mountains altogether and the professional adaptation being difficult, one respondent suggests that ‘on the contrary, customers are more likely to ask for professionally guided hikes’ (S72). Another respondent explained: ‘I think it’s an opportunity for guides and mountain leaders to bounce back from this. Rather than saying to ourselves, oh dear, we’re not going to be able to do anything any more. No. On the contrary, we’re going to be more in demand’ (I3). As conditions become more difficult to interpret or manage, the value of professional supervision, particularly in route selection and ensuring group safety, may rise. This view is reinforced by the belief that ‘an increase in risks in the mountains means that a mountain leader will become helpful, similar to mountain guides at higher altitudes, to have experience’ (S88).

At the same time, several mountain leaders suggest that another dimension of increased demand may emerge not from risk perception, but from a growing interest in a more sustainable and ‘green’ tourism. Climate change is seen by some mountain leaders as a potential catalyst in shifting people’s preferences away from high-emission holidays towards more local, nature-based experiences. One respondent

pointed to ‘an expansion of the clientele with more and more people sensitive to nature, due to global warming as a trigger’ (S2), while another noted that ‘more people are aware of the issue and would choose "green" vacations (in nature with a mountain leader) rather than vacations on a beach or on a cruise abroad’ (S20). This form of demand is not only about safety, but about values and lifestyle. One mountain leader speculates that clients ‘will want professionals to ensure their safety in a mountain that is becoming increasingly "dangerous"’ (S18), but also that they will seek guidance and knowledge: ‘more and more people will seek explanations’ (S18). This opens space for offers framed around environmental sensitivity, as one mountain leader noted: ‘I can present my offer as particularly respectful of the environment, but it must be implemented in a consistent way’ (S9).

#### 3.3.10.4 New Offers

The potential increase in demand for more sustainable outing options highlights another opportunity of climate change. Some mountain leaders recognize a space to offer new products, come with new ideas and to be catalysts for innovation in their profession. Some of the interviewees shared, ‘I think we need to be curious, you need to have ideas and then we will all find something to do’ (I1) or ‘Yes, it's up to us to adapt and come up with nice ideas’ (I2), both reflecting a mindset of creativity and adaptability. One respondent draws their inspiration from nature, sharing that, ‘I think that nature adapts better than we do. So if we are interested in plants, there will always be something to talk about, something to see’ (I1).

Linked to this is a recognition that climate change creates space to evolve beyond traditional routines. One respondent explained: ‘So I think that yes, it can have an impact, but the fact that I'm bouncing back means that I'm doing something else. And I like it because, after a while, I get fed up doing the same thing over and over again. In terms of the activities, I enjoy doing it differently, or discovering new locations’ (I3). This feeling is echoed in other survey responses that reference ‘other activities to set up’ (S11), ‘new ideas regarding hikes, excursions’ (S60). In this sense, climate change, while making certain offers such as snowshoeing more difficult, also pushes mountain leaders to rethink and diversify what they offer, which clearly some appreciate as an ‘opportunity to do things differently and change our habits’ (S51).

In parallel to this, a number of mountain leaders highlight the potential to increase environmental education and awareness through guided excursions. Some stress the opportunity to ‘raise awareness of climate change (flora, fauna, landscapes...)’ (S13) and to see the role of mountain leaders as a ‘nature guide’, with ‘a mission to open minds [...] perhaps motivating [clients] to lead a life more conscious of nature’ (S25). These outings might be more philosophical: ‘showing the power of nature to evolve’ (S26) or ‘how nature adapts’ (S28); or directly educational: ‘organizing hikes on this theme’ (S41) or

exploring ‘opportunities for education and transmitting information’ (S17). Several see the opportunity to put forward the pedagogical and interpretive dimension of the profession, and encourage a broader social shift towards sustainable awareness.

### 3.3.11 Training

When it comes to the question of training on climate change, responses from mountain leaders show considerable diversity. A number of respondents report that the topic is now integrated into the standard training curriculum for hiking guides, covering both the science of climate change and its practical implications. One mountain leader explains that ‘the aspect of climate change is part of the training of mountain leaders in all its facets: safety, weather, botany, history, nivology, glaciology, etc.’ (S3), while another notes that ‘in our training as hiking guides, we learn how the earth was formed and how it has continued to develop... climate change... was also dealt with in the practical part, there within the topic of risk management’ (S70). Similar comments include ‘this was always discussed as part of the training programme’ (S87) and that it ‘is now generally part of hiking guide training’ (S73). Others mention it being included in specific modules, such as ‘meteorology’ (S97) or within their Swiss mountain leader training courses (S94, S101, S103).

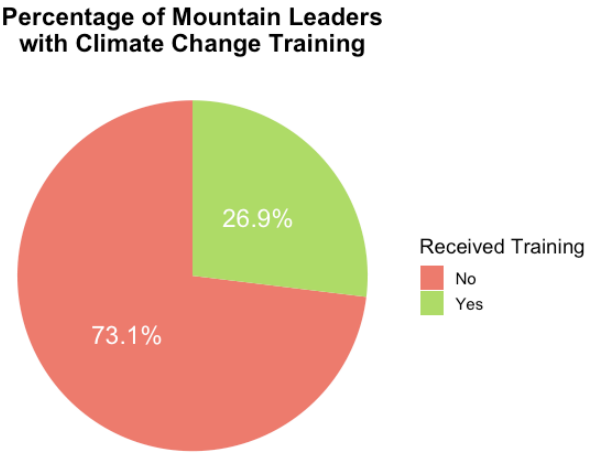


*Figure 32: Total Percent of Mountain Leaders with Climate Change Training*

Yet, despite these testimonies, it should be noted that the majority of survey respondents stated they had not received any training on climate change (Figure 32), which suggests that the integration may be inconsistent or only recently introduced. A call with Sarah Kleinknecht, secretary of the Swiss Association of Mountain Leaders, confirmed that climate change is integrated into the training, however verifying this within each training school was not within the scope of this thesis. It would be very interesting to perform an analysis of each training program and investigate whether and where the topic is covered in the syllabus. It is important to note, however, that the topic of ‘climate change’ is never explicitly or implicitly mentioned in the ‘Chart of Professional Activities of Mountain Leaders’ (Christen et al., 2008) which outlines the official training content for the Swiss mountain leader qualification.

An examination of Figure 33, which shows the percentage of mountain leaders who have and have not followed specific climate change related training by level of experience shows that it is the most and least experienced who have the greater majority of respondents reporting having received training. The specific data shows that of those in the 21+ year categories, all those who responded 'yes' was due to content in continued professional development courses. In contrast, all those in the category 0-2 years mention their training as having been part of their main mountain leader training. Almost all respondents in the category 3-5 years who had received training noted this was also via continuing professional development and were optional topical courses. This demonstrates that climate change related topics have probably been increasingly included in basic training only in the very recent years, in a way not previously present.

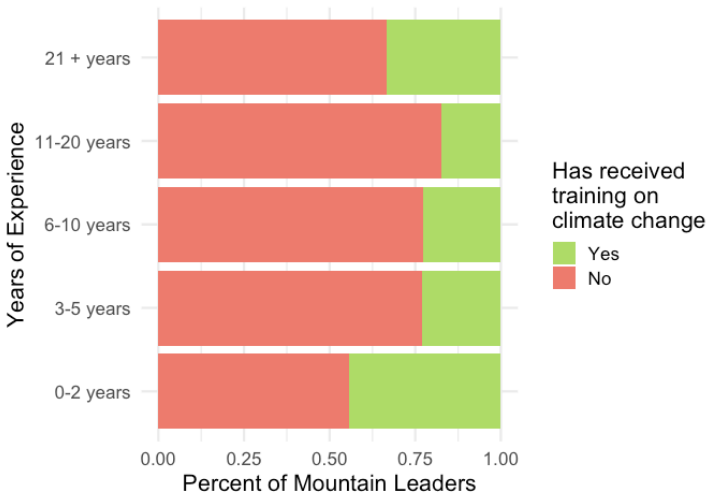


*Figure 33: Climate Change Training by Years of Experience*

As implied above, many mountain leaders are able to obtain training on the topic through continued professional development courses. Some mention attending topical courses, such as 'a one-day course on the effects of climate change on our professions' (S21) or similar (S58, S79, S30, S83). A number of mountain leaders reported learning about the topic independently or informally (S98), such as 'reading, reports, discussions, podcasts' (S5). A more formal approach, yet still under the cover of self-study, was described by one respondent who shared that they 'took and completed the UNIGE Coursera course 'Climate Change and Water in Mountains: A Global Concern' (S24). In addition, a small group of respondents referenced academic backgrounds that prepared them for understanding the effects of climate change. This includes holding degrees in environment related topics such as geography or geomorphology (S10, S13, S25, S30, S38, S62, S82, S100),

Together, these responses show that while many mountain leaders have some degree of formal or informal education on the topic of climate change, the level of official and formal training still varies widely.

# 4 Discussion

## 4.1 Leading through Change – The Reshaping of a Profession

In answer to the **first research question** about the **impacts** of climate change on the mountain leader profession, this study found that climate change does significantly impact mountain leaders. Firstly, through changes in the weather and general climate, such as increasing temperatures and increasingly extreme and unpredictable weather events. These can lead to an increase in flooding, landslides, and rockfalls, all of which may result in path closures, which directly affect the work of mountain leaders. Changes in seasonality are also among the biggest impacts, notably the winter which is becoming less reliable, with decreasing snow cover especially at lower altitudes, making the practice of snowshoeing more and more difficult.

In answer to the **second research question,** this study was able to highlight a number of key **adaptation strategies**, which take on different dimensions and forms. Firstly, mountain leaders spend more time in the planning phase, going on recces and paying increased attention to their route plan. Secondly, they use spatial adaptations by moving locations or going higher in altitude. A third strategy is temporal adaptations, either by changing the dates of hikes or by modifying the schedule of the day itself, and in the worst case, by cancelling. Mountain leaders also diversify their activities, for example, by walking in winter and not snowshoeing, and by having other jobs as sources of income. Finally, they increase their safety measures, notably by carrying safety equipment more frequently and by being more attentive to risks on the hill. Another dimension of adaptation was to do their part in decreasing their carbon footprint, with the most common strategy being the use public transportation in their work as mountain leaders.

### 4.1.1 Hypotheses in Practice

Diving into more detail on how these results align with the **hypotheses** posed (or not), we can see that:

The findings of this study support hypothesis **H1**, which predicted that **changes in seasonality** would affect mountain leaders, particularly through the reduction of snow cover at lower altitudes. Mountain leaders did indeed report shorter and less predictable winter seasons, making activities like snowshoeing increasingly difficult, especially at mid and low altitudes. This aligns with the hypothesis that a shift in the seasonality of mountain activities would be one of the primary impacts of climate change.

Similarly, the study confirms hypothesis **H2**, suggesting that mountain leaders face the impacts of **increased natural hazards**, such as increased rockfall, landslides, and flooding. However, it is

important to note that it is usually the resulting path closure due to these events that is the resulting problem, rather than the hazard directly putting mountain leaders in danger. Though in the case of rockfall events (and flooding to a much lesser extent) it can be the case.

The findings of this study provide a nuanced understanding of hypothesis **H3**, which suggested that hazard mapping and planning would be valuable tools in decision-making for mountain leaders. While the results do not indicate an explicit increase in formal hazard mapping per se, they do reveal that mountain leaders are increasingly relying on digital maps to monitor trail conditions and closures. Tools like SwissTopo and SwissMobility have become crucial in planning, as leaders frequently refer to maps showing closed paths and areas affected by environmental hazards such as landslides or flooding. Although this is not identical to comprehensive hazard mapping, it highlights the increasing reliance on up-to-date, digital maps to navigate path closures as a result of natural hazards.

In line with hypothesis **H4**, the findings show that mountain leaders are adapting to these challenges by changing locations and activities. With snowshoeing becoming less reliable, many leaders are substituting other winter activities, such as hiking, to maintain their offerings. In cases of path closures or poor snow conditions, mountain leaders regularly report changing areas, altitudes, or routes to find appropriate terrain.

The findings of this study support hypothesis **H5**, which suggested that mountain leaders would need to devote more time to assessing weather conditions. In addition, leaders also reported spending more time monitoring route conditions in general as well as phenology for themed outings.

Hypothesis **H6**, which proposed that mountain leaders' inherent flexibility would enable them to diversify their activities, also proves true. Many leaders have diversified their offerings, such as shifting from snowshoeing to winter hiking, in response to the uncertainty surrounding snow conditions. However, the findings also suggest that not all leaders are equally successful in this substitution, with some reporting challenges in maintaining client interest with decreasingly snowy landscapes.

In terms of available terrain due to glacial retreat, which validated hypothesis **H7**, the study found that as glaciers recede, areas previously outside mountain leaders' remit are now no longer under ice, thereby presenting new route options.

Hypothesis **H8**, which anticipated minimal impacts from vegetation changes, was largely confirmed. While mountain leaders observed shifts in flora, such as upward migration of plant species, these changes were not viewed as significantly affecting their work, except in the planning phase, where mountain leaders need to pay more attention to what is happening on the ground, as seasonality becomes less predictable.

The findings of this study are mixed regarding hypothesis **H9**, which suggested that climate change impacts and adaptation strategies would be included in mountain leader training. The content and extent of this training isn't clear, and there are varied responses as to who received training, in what context, and what about. It would be helpful to include climate change impacts and adaptation strategies in basic training, and to do so by taking a holistic approach so as to include the topic across multiple training areas.

Finally, hypothesis **H10**, which proposed that mountain leaders could serve as "sentinels" of climate change by educating clients, was supported. Most leaders reported discussing climate change during their outings, incorporating observations about changes in the environment into their interpretive work, thus fulfilling this role.

## 4.2 Interpretation of Key Findings

### 4.2.1 Impacts of Climate Change

#### 4.2.1.1 Changes in Climate Conditions

The results of this study strongly align with the established literature on climate change in mountain regions, particularly the increased temperatures and elevation-dependent warming (EDW) observed in both the Swiss Alps and globally (Rebetez & Reinhard, 2008; Palazzi et al., 2019). Mountain leaders consistently reported rising temperatures, particularly in the summer months, which made hiking conditions more challenging while also increasing health risks such as dehydration, heat stroke and sunburn. These findings support the theory of elevated warming at higher altitudes, which is expected to continue (Klein, 2018; Rebetez & Reinhard, 2008). While some mountain leaders acknowledged that warmer temperatures sometimes provided pleasant conditions for outdoor activities, the overall sentiment was that these temperature increases are more often detrimental to their work. As observed in the literature, increased warmth at mid-altitudes, where most mountain leaders operate, has led to a reduction in reliable snow cover, significantly impacting traditional winter activities like snowshoeing (Klein, 2018; NCCS, 2018). The reported shift towards longer summer seasons and shorter, more unpredictable winters aligns with the findings in the literature review, where it is noted that snow cover duration is expected to decrease at lower elevations (NCCS, 2018).

#### 4.2.1.2 Increase of Hazards

The experience of mountain leaders described in this study align with findings for other mountain professionals, particularly mountain guides and hut wardens, as described in the state-of-the-art. They

all face similar challenges with the increased frequency of hazards like rockfall, landslides, and flooding. The state-of-the-art highlights that mountain guides in the Alps, for example, are encountering more rockfall and instability in the terrain due to warming temperatures and the retreat of glaciers (Carlson et al., 2021; Mourey et al., 2020). Similarly, mountain leaders in this study reported an increase in rockfall and landslides, which were also noted by hut wardens dealing with increased erosion and path (Miczka, 2022). In all cases, these hazards disrupt access, increase risk on the hill and require more time and effort in planning and ensuring safety.

#### 4.2.1.3 Changes in Seasonality

The shifts in seasonality reported by mountain leaders align with those reported by mountain guides and hut wardens, particularly regarding the winter season. As noted by guides, the warming climate has shortened the winter season, with snow cover diminishing earlier in the year and becoming less reliable throughout the season (Carlson et al., 2021; Mourey et al., 2019). This is in direct alignment with the findings of mountain leaders in this study, who also highlighted the decreasing reliability of snow for activities like snowshoeing, especially at mid-altitudes. The literature review showed that both mountain guides and hut wardens noted a shift toward longer summer seasons, with the summer guiding season starting earlier and extending into the shoulder months (Carlson et al., 2021; Mourey et al., 2019; Salim et al., 2019), which mirrors the extension of the summer season reported by mountain leaders.

#### 4.2.1.4 Decreased Predictability

Parallel to changes in seasonality, the growing unpredictability of conditions is another area where the results for mountain leaders and those for mountain guides converge. In the state-of-the-art, mountain guides reported that the changing weather and snow conditions have made seasonal patterns increasingly difficult to predict, leading to significant logistical challenges in trip planning (Carlson et al., 2021; Chevaillot et al., 2006; Mourey et al., 2020). This is echoed in the results for mountain leaders during the winter season especially, who noted the increasing difficulty of reliably planning snowshoeing trips, with snow conditions often fluctuating unpredictably from year to year. The findings for both mountain leaders and guides emphasize how the variability of weather over all seasons has made it more difficult to forecast conditions accurately in advance and therefore plan outings accordingly.

#### 4.2.1.5 Decreased Attractiveness

The decreased attractiveness of the mountain environment, driven by climate change, affects mountain leaders, guides, and hut wardens. Mountain guides and hut wardens have observed that the loss of

glaciers and changing landscapes have reduced the visual appeal of certain routes and huts, impacting client interest (Carlson et al., 2021; Miczka, 2022). For mountain leaders, this issue manifests in the difficulty of attracting clients either for snowshoeing tours, or 'winter hiking' as a replacement, when the landscape they see is not the 'winter wonderland' they imagined. While not identical to the broader aesthetic changes faced by guides and hut wardens, mountain leaders specifically struggle with maintaining the allure of winter excursions due to the lack of snow, making it harder to generate interest in these kinds of tours.

This raises important questions about the perception of winter landscapes and how these imaginaries are constructed. As climate change reshapes the environment, it seems crucial to question whether the idealized version of winter that is commonly held, one of snow-covered trees and peaks and powder-filled slopes, still aligns with the realities of the climate in Switzerland. How can these expectations be reshaped so that potential clients understand that idealized winter conditions may no longer be as probable? Not necessarily one that promotes a negative or overly pessimistic view of winter, but rather one that encourages a more realistic perspective. One of the challenges that mountain tourism professionals face in winter, then, is how to communicate the changing realities of the mountain winter environment, fostering a mindset shift that appreciates and embraces these new conditions, rather than holding out for the traditional 'perfect powder' that may no longer come.

Such a shift in perspective would require not just mountain leaders to adjust their messaging but also broader changes in how winter activities are marketed and understood. If the portrayal of winter activities could be adjusted to align more closely with the current climate realities, it could help clients enjoy mountain experiences despite the inconsistency of snow conditions. Exploring how these winter imaginaries are formed, maintained, and how they can be adapted to reflect the evolving environment, could be an important area for further research. This would not only help mountain leaders adapt their offerings but also offer a more sustainable and realistic approach to enjoying winter in the mountains.

### 4.2.2 Adaptation Strategies

#### 4.2.2.1 Increased Time Spent Planning

Mountain leaders in this study report spending more time on planning, particularly due to the unpredictability of weather and terrain conditions. This mirrors findings for mountain guides, who also noted the growing time commitment required for assessing weather forecasts and route conditions (Bourdeau, 2014; Mourey et al., 2020; Salim et al., 2019). Both groups have adapted by investing more effort in pre-trip planning to ensure client safety and to navigate increasing environmental uncertainties. Guides report increased reliance on social media, digital tools and weather apps to assess in as much

detail as possible the conditions for excursions (Mourey et al., 2020). Similarly, mountain leaders in Switzerland rely heavily on a variety of digital tools to be aware of accessibility and conditions indicating a shared adaptation between these two professions in response to the need for more precise planning. Going on recces was often mentioned by mountain leaders in a manner not mirrored by mountain guides, probably due to the more complicated logistics for the type of outings that mountain guides lead.

However, while this increased time investment in planning is crucial for ensuring safety and adapting to climate change, it is also important to question whether it has economic implications for mountain leaders. The additional time spent on reconnaissance trips, for example, may result in higher operational costs, as it involves extra time and transportation. These costs could put financial pressure on mountain leaders, especially those working as freelancers or in small businesses, as they might not be able to pass these additional costs onto clients. This raises questions about the economic viability of such adaptations: is it sustainable for mountain leaders to spend more time planning and in recces without compensating for the additional resources? Or how could a proper compensation for this time spent be envisaged? Moreover, as the industry already faces seasonal fluctuations and financial uncertainty, the need for mountain leaders to spend more time on preparatory work could further strain their business models. If not properly compensated, these short-term adaptations could potentially affect the long-term sustainability of their work.

In the planning phase, there is also the question of last-minute planning on the clients' end, as a one interviewee raised (I8). This points to a broader social shift towards spontaneity and last-minute bookings and decision-making, which further complicates planning and peace of mind for mountain leaders. The lack of predictability in client behaviour makes it harder to gauge demand and plan accordingly. This evolving dynamic highlights how broader societal trends are influencing the profession, introducing new challenges to an already complex planning process.

#### 4.2.2.2 Spatial Substitutions

Spatial substitutions, or changing the locations of activities due to inappropriate conditions, are another key adaptation for both mountain leaders and guides, though they take slightly different forms. Guides report regularly adjusting their routes or regions to find safer or more feasible conditions (Hanly & McDowell, 2024; Mourey et al., 2020; Rushton & Rutty, 2023; Salim et al., 2019). Mountain leaders similarly adjust spatially, but mostly by going to higher elevations, notably in winter and to find better snow conditions. In cases of path closure, mountain leaders may either adapt the route or change the area entirely.

An interesting point of discussion is how regional factors might influence these spatial adaptations. For instance, some mountain leaders in the Jura have reported discontinuing snowshoeing activities altogether, due to the increasingly unpredictable snow conditions in that area. In contrast, mountain leaders working in higher-altitude regions of the Swiss Alps may be more likely to adjust by simply moving to higher elevations, where snow conditions are often more favourable. It is likely that the geographical characteristics of each region, such as snow cover, elevation, aspect, and local climate conditions, may shape the nature of spatial adaptations. This could suggest that regional variations might require mountain leaders to implement different strategies based on the specific challenges posed by their environment. For example, in areas with more unpredictable snow, like the Jura, mountain leaders may need to be more flexible in choosing *alternative activities* rather than adjusting their routes. Meanwhile, those working at higher altitudes may be in a better position to use spatial substitution by going higher elevation to ensure better snow conditions.

These potential regional disparities highlight an important consideration: adaptation strategies may not be uniform across different regions. Whether mountain leaders in different areas of Switzerland require context-specific approaches to adaptation remains an area worth exploring further.

#### 4.2.2.3 Temporal Substitutions

Both guides and mountain leaders have also adapted by altering the timing of their activities, which involves shifting dates or adjusting schedules to align with more favourable conditions. In the case of mountain guides, studies indicate they are rescheduling trips to accommodate longer summer seasons and more unpredictable snow conditions (Bourdeau, 2014; Hanly & McDowell, 2024; Mourey et al., 2020; Rushton & Rutty, 2023; Salim et al., 2019). Similarly, mountain leaders in Switzerland have adapted by rescheduling snowshoe tours in winter or treks to earlier or later in summer, or adjusting the timing of outings to avoid extreme weather events, like heatwaves or storms, that are becoming more frequent in the summer months. This temporal substitution strategy, as illustrated in Figure 34, is aligned with the need to adjust to the increasingly irregular weather patterns that make planning activities more challenging, confirming a shared adaptation across both professions.

While daily temporal substitution, such as moving the schedule forward or backward by a few hours, is usually a manageable adjustment, seasonal temporal substitutions might present more complex challenges. Shifting activities to times that were previously considered off-season, such as winter activities being moved to earlier or later months, raises interesting questions about client flexibility and tourism cycles. For instance, moving snowshoe tours into the shoulder months or adjusting summer treks to avoid the most extreme heat could require client willingness to travel outside the traditional peak season. This brings up a key issue: how adaptable are clients, particularly those coming from

abroad, in adjusting their schedules? While some clients may welcome a less crowded experience in the shoulder seasons, others may expect trips to align with holiday windows, and might be hesitant to travel outside these times.

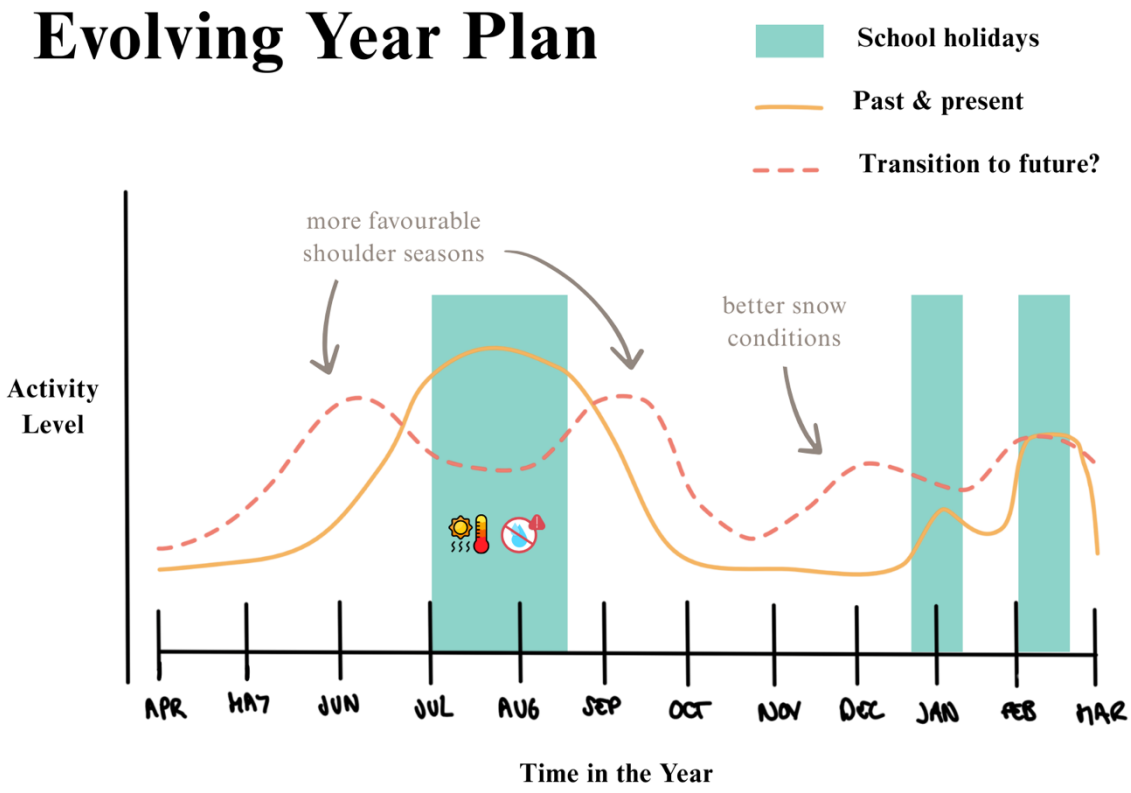


*Figure 34: Proposal of a future year plan for mountain leaders, compared to the current yearly activity level.*

Tourism infrastructure could play a significant role in facilitating temporal adaptations, particularly when it comes to shifting activities into off-season periods. As noted in the state-of-the-art, the success of extending the tourism season or adapting activities outside traditional time frames is often contingent upon the coordination of various stakeholders, such as mountain huts, lifts, and access roads (Miczka, 2022). If key elements of this infrastructure aren't aligned, it makes the successful running of off-season activities difficult, even if mountain leaders, or others such as hut wardens or guides, are willing to adapt. This interconnectedness suggests that temporal substitutions for mountain leaders may depend not just on their own flexibility but also on how well the entire tourism network is able to accommodate these changes. While it might be possible for mountain leaders to adjust their schedules, the broader tourism ecosystem, from accommodation to transport, needs to be ready to support those changes. However, as the current tourism models often lack the flexibility needed for quick adaptations, the ability to shift activities seamlessly into off-seasons is limited. This raises important questions about

how well the infrastructure can evolve in response to the increasing unpredictability of the climate and the shifting needs of mountain professionals. Therefore, while temporal adaptations might seem like a logical solution, their effectiveness is closely tied to the collaboration and planning of all involved, and whether this interdependence can be effectively managed remains uncertain.

#### 4.2.2.4 Activity Diversification

Activity diversification is a key adaptation strategy observed in both mountain guides and hut wardens, and it also applies to mountain leaders. In the case of mountain guides, as outlined in the literature review, guides have increasingly moved towards diversifying activities to mitigate the uncertainties linked to climate change. This includes offering activities such as climbing schools, mountain biking, trail running, and via ferrata, which are less dependent on specific weather conditions and more predictable than traditional high-mountain alpinism (Bordeau, 2014; Carlson et al., 2021; Mourey et al., 2019). Similarly, some mountain huts have diversified by adapting their infrastructure to accommodate different activities, like mountain biking or climbing, thus attracting a broader clientele beyond traditional alpine tourists (Miczka, 2022). Mountain leaders, facing similar challenges, have also begun diversifying their activities. With the decline in reliable snow for snowshoeing, many mountain leaders are now offering alternative winter activities, such as winter hiking, to maintain client interest and ensure their services remain viable. Mountain leaders also diversify financially by having other jobs as alternative sources of income beside their guiding, to ensure a viable revenue.

An intriguing possibility for future activity diversification, particularly in regions where snow conditions are increasingly unreliable for traditional winter sports, is the potential role of school-based mountain activities. As school skiing weeks, or days, become less feasible due to diminishing snow cover, could there be an opportunity to replace these programs with mountain weeks/days, led by mountain leaders? This suggestion, raised by one respondent (S6), proposes that rather than focusing solely on skiing, school groups could spend that time learning about various dimensions of mountain environments under the guidance of professionals. Such a shift would simultaneously increase the next generations' understanding and appreciation of nature as well as offer many new work opportunities for mountain leaders. This could be a positive way to increase the educational value of students' experiences in the mountains, especially as traditional snow-based activities decline. In this sense, it would align well with growing interest in outdoor education and environmental awareness, as it could expose students to more sustainable, nature-based activities while still providing a physically enriching and fun experience in the mountains. While such a shift would take time and require careful planning and coordination with the schooling system, it highlights a potential for mountain leaders, offering new opportunities for both professional development and activity diversification.

Another suggestion offered by multiple mountain leaders in diversifying activities is to swap snowshoes for micro-spikes (or mini crampons) in conditions where the latter would be more favourable, such as icier or just generally less fresh snow (S10, S24, S39, S54). This raises questions however, as to the current legislation surrounding equipment available to mountain leaders. According to Swiss law, 'apart from snowshoes, no technical aids such as […] crampons […] have to be used in order to ensure the safety of the clients.' (Ordinance on Mountain Guides and Organisers of Other High-Risk Activities, 2019). While this law is designed to clearly define and differentiate the remit of different mountain professionals, it may not fully address the evolving conditions that mountain leaders are encountering as climate change alters terrain and snow conditions. Micro spikes, which are designed for hikers and are far lighter and less specialized than traditional mountaineering crampons, could provide a practical solution in situations where snowshoeing is no longer viable, but the terrain requires extra traction (Figure 35). However, a legal grey area exists here: are these mini-crampons considered 'crampons', which are traditionally associated with high-mountain equipment and typically fall under the remit of mountain guides? If so, this could create regulatory issues for mountain leaders who are now faced with adapting to changing conditions but are constrained by existing laws that may not be flexible enough to accommodate newer, more accessible forms of equipment. This brings up an important question of how the legal framework might also to need to adapt to the changing realities of mountain environments, in a way that both protects all mountain professions and enables them to develop and flourish.


*Figure 35: Micro Spikes vs Crampons (Mountaineering Scotland, n.d.)*

#### 4.2.2.5 Increased Security Measures

The literature review found no explicit mention of mountain guides adopting additional security measures, likely because they already follow stringent safety protocols due to the inherent risks of their

profession. In contrast, mountain leaders reported becoming more attentive to risks on the hill, as well as carrying emergency equipment more frequently in response to the growing unpredictability of weather and terrain conditions.

One could raise a similar discussion to the one above on micro-spikes about the extent to which increased security measures remain within the remit of mountain leaders. As mountain leaders are faced with more hazardous terrain and unpredictable conditions, some have begun using additional safety gear, such as ropes or helmets, more regularly to manage these risks. This raises an important question: at what point does the use of such equipment cross into the domain of mountain guides? Traditional distinctions between mountain leaders and mountain guides are based on the complexity of terrain as well as the required technical skills and equipment, yet the evolving environment and resulting adaptation strategies are starting to blur these lines. While ropes and helmets are typically associated with more technical, high-mountain activities led by guides, the question arises as to whether these tools should be more routinely incorporated into the work of mountain leaders, given the challenges posed by the changing environment.

As discussed above, this again raises the question: should the legal framework evolve to recognize the changing realities of the mountain leader profession? If mountain leaders are increasingly wanting to use ropes or helmets in their practice to mitigate heightened risks, does this mean the boundaries of their role should be expanded to reflect the more technical demands of their work? Alternatively, could the current laws be updated to ensure that mountain leaders have the legal clarity to use such equipment when necessary, without overstepping the scope of their qualifications and maintaining a clear distinction with the realm of mountain guides? As climate change continues to alter the conditions in which mountain leaders exercise, there may be a need for an adaptation of the legal framework that recognizes the changing mountain landscape and ensures that mountain leaders can continue to operate safely.

#### 4.2.2.6 Reducing Personal Impact & Raising Awareness

The ways in which individuals can reduce their working carbon footprint were not often discussed in the literature on guides and hut wardens, though it was a frequent topic among mountain leaders. Many leaders recognize their role in reducing, where possible, their contribution to climate change. In addition to practical measures, both the literature and this study emphasize the important role of mountain leaders in raising awareness about environmental changes. By educating clients on how the environment is evolving, mountain leaders help foster greater environmental consciousness. This aligns with the role of mountain huts, which are often referred to as ‘sentinels of climate change,’ raising awareness among visitors about the ongoing shifts in the mountainous landscape (Refuges Sentinelles – Refuges

laboratoires de haute montagne, n.d.). In both cases, these professionals act as crucial links in promoting broader environmental stewardship, which is something that most guides, according to the literature, do not yet see as an integral part of their role.

#### 4.2.2.7 Long-Term: Adaptation of Training

The integration of climate change into training programs for both mountain guides and mountain leaders is a strategy that appears to still be in the early stages of implementation. For mountain guides, while the idea of incorporating climate change into training has been widely suggested in the literature as a crucial long-term adaptation (Bourdeau, 2014; Carlson et al., 2021; Hanly & McDowell, 2024), it remains unclear how comprehensively this has been implemented. This study shows that mountain leaders report more varied experiences regarding training on climate change. Some respondents noted that it is already part of standard hiking guide training, covering aspects like safety, weather, and risk management. However, despite these testimonies, the majority of survey respondents indicated they had not received formal training on climate change, highlighting an inconsistency in how climate change is integrated into training programs. While continued professional development courses and informal learning options exist, such as online courses and self-study, climate change remains largely absent from the official certification content for Swiss mountain leaders. This suggests that, while awareness and individual efforts to learn are present, systematic and formalized training programs for mountain leaders still require significant development to fully address the evolving challenges posed by climate change.

In summary, similar to mountain guides, mountain leaders' adaptation to climate change is influenced by a combination of internal and external factors. Internal factors such as their willingness to embrace flexibility and creativity help drive adaptation, enabling them to diversify their activities or adjust their approach to changing conditions. However, external factors, like client expectations and organizational constraints, can hinder this process**.**

#### 4.2.2.8 Seasonal Differences

It appears that it is both harder to adapt to changes in winter and that these adaptations are less able to maintain profitability. The reason for this is that summer probably provides easier alternatives than winter. In summer, if a path is closed due to a natural hazard, there are many other similar route options available. In winter this is less obvious, especially if the reason for needing to change plans is a lack of snow. If, for example, there is no snow below 1500m, that limits the possible area for going snowshoeing to a far smaller area, where terrain constraints such as slope angle become more difficult

to manage. Whereas in summer there are more easily accessible possibilities as the conditions are less complicated to manage.

It is interesting that experience does not appear to influence the difficulty of adaptation, which was not be the expected outcome. The reason for this finding could be that the more experience a mountain leader has, the more they notice changes in conditions, leading them to report a greater need for adaptation. On the other hand, with more experience, leaders may become more accustomed to adapting to various challenges, whether related to climate or other factors, making adaptation easier. These two factors could potentially balance each other out, resulting in no significant difference in adaptation difficulty based on experience.

#### 4.2.2.9 Regional Differences

The results demonstrate that mountain leaders working predominantly in the Prealps show a significantly higher likelihood of using spatial and activity substitution strategies. This is likely linked to the region's reduced and less reliable snow cover. Given the Prealps' topography and the rising snow line, it is unsurprising that mountain leaders in the area often adapt by relocating to find snow or by switching from snowshoeing to hiking-based activities.

One might expect a similar trend in the Jura, which also faces challenges related to reduced and unpredictable snow cover in winter. However, the Jura is arguably more geographically isolated, with fewer nearby higher-altitude alternatives. This may explain why spatial substitution is used less frequently there, despite a regular use of activity diversification.

The observed increase in planning, security measures, and temporal adaptations with altitude likely reflects the greater inherent risks of working in higher alpine environments. These conditions demand more meticulous planning and adaptive scheduling, especially in summer. In contrast, spatial adaptations appear to be consistently employed across all altitudes and regions. This stands to reason, as such strategies, involving changes in location, altitude, or region, are applicable to a wide range of hazards and seasonal conditions.

The results related to regional differences reveal some interesting patterns that merit further investigation. For a more accurate study of spatially linked phenomena, it would be important to clearly differentiate between specific regions (see section 4.4 Limitations of the Study). A future study could more precisely examine **which environmental impacts mountain leaders experience in each region**, as well as **the specific adaptation strategies** they employ in response. This would allow for a more detailed and comparative understanding of how climate change affects different mountainous areas across Switzerland.

## 4.3 Implications and Applications of Findings

### 4.3.1 On Current Theory

The findings of this study align with much of the existing literature on climate change's impact on mountain professionals, particularly in terms of increased hazards and changing environmental conditions and seasonality. However, there are key differences in how these impacts manifest for mountain guides and mountain leaders, showing that there remains a need to better understand the latter profession and how it relates to a changing climate.

In the case of mountain guides, they typically face high-altitude challenges, such as permafrost melt, serac breakoff, and reduced ice cover, which are well-documented in the literature as directly related to climate change. These hazards directly affect their routes and safety, and are central to the discourse on mountain professional adaptation. In contrast, mountain leaders, while also affected by broader climate shifts, encounter challenges that are less often discussed in relation to their profession. Extreme weather events, like storms, floods, and heatwaves, increasingly disrupt mountain leader operations, but these events are not commonly linked to mountain leaders in existing research. Similarly, the unpredictability of snow cover at mid-altitudes, which significantly impacts snowshoeing and other activities, is another major issue for mountain leaders that has received less attention in the literature, which tends to focus more on other mountain activities, such as alpine skiing or guiding.

In this sense, while both mountain guides and leaders face challenges due to climate change, mountain leaders are more affected by dimensions of climatic evolutions that are less frequently highlighted in the literature. This points to the need for expanded theories that better address the specific challenges faced by mountain leaders within their remit.

### 4.3.2 On Current Legislation

As mentioned in the discussion on activity diversification and increased security measures, questions were raised about whether current legislation framing mountain leaders' remit is still completely relevant, or whether a revision of the law is necessary. The question is mostly around the use of technical equipment, firstly by giving clear directives on the use of micro-spikes (mini crampons), and secondly on the regular and/or planned use of security equipment such as ropes and helmets. It could be helpful for all stakeholders if these legal grey areas are addressed. Revising the legal framework to reflect these new realities could provide clearer guidelines and better support for mountain leaders in managing the challenges posed by climate change.

### 4.3.3 On Technical Applications

One key technical improvement that could significantly support mountain leaders' adaptation to climate change is the development of a centralized digital platform for sharing up-to-date and accurate knowledge on area and route conditions. As climate-induced hazards such as landslides, flooding, and rockfall increasingly disrupt planned routes, as well as snow fall and cover being increasingly unpredictable, having access to real-time information about conditions such as the state of the path or the snow cover and quality would allow mountain leaders to adjust their plans in a well-informed and efficient manner. Currently, leaders rely on a mix of local knowledge, digital tools like SwissTopo, and informal networks to gather such data, but these resources are often fragmented and time-consuming to compile. A centralized platform, supported by locals and professionals, would streamline information-sharing and enable more efficient planning and risk management.

### 4.3.4 On Professional Practice

In terms of professional practice, it is crucial for mountain leader training programs to engage with climate change, as it effects so many dimensions of their profession. It is essential that this be done in a holistic way, by not simply looking at the theoretical aspects, but also in a way that equips mountain leaders with a toolkit of practical adaptation strategies. While many mountain leaders already implement strategies such as spatial substitutions or activity diversification, formal training could serve as an opportunity to systematically present these strategies, helping leaders recognize when and how to apply them in different scenarios. For example, while some leaders instinctively change locations or switch to hiking instead of snowshoeing, others might benefit from more structured guidance on when and how to implement these strategies. By framing both the impacts and the adaptation strategies within the context of official training, mountain leaders would gain better understanding of the issues surrounding climate change in the mid-mountains, as well as greater confidence in their ability to navigate these. In this sense, formal climate-change training would ensure that they are not only reactive but proactive in their approach to adapting to a constantly evolving environment.

## 4.4 Limitations of the Study

This study offers valuable insights into the impacts of climate change on mountain leaders. There is limited previous research specifically focused on mountain leaders, and although research on mountain guides is helpful, there is a lack of a substantial body of literature on this topic. This study has taken some initial steps in meeting that lack.

However, the study is subject to several limitations. Firstly, the study focuses exclusively on mountain leaders in Switzerland, limiting its generalizability to regions with different environmental and social contexts. Additionally, while the sample size represents about one-sixth of ASAM's members, it remains limited and may not fully capture the diversity of perspectives and experiences. There is also potential bias, as those who responded may have been more inclined to be interested in or concerned about climate change, while others might have been indifferent or sceptical. Of those who did respond to the survey, none who gave more negative responses responded to the question about agreeing to be interviewed, thus creating an additional self-selective bias.

The study was conducted in English, however the data collected was in English, French, German, and Italian. The majority of the survey responses were in French and German and the interviews in French or English. Since this was not always my or the respondents first language, some responses may not be exactly what the speaker intended to say, or translations might not do justice to how the respondent meant them, impacting the accuracy of the responses.

Furthermore, although the survey provides concise and structured data, it does not allow for the same depth of exploration as interviews. The small number of interviewees limits the ability to capture a broader range of individual experiences and insights, though it does help.

A limitation created by the way in which the altitude and location questions were posed in the survey didn't allow for precise spatial analysis of patterns. This is due to the fact that mountain leaders were able to report working at multiple altitude groups as well as in different regions. While this reflects the reality of their practice, it creates a difficulty in pinpointing trends to specific spaces.

An additional limitation is the inability to fully address other cultural or social factors that may contribute to some of the challenges mountain leaders experience. For example, several respondents mentioned that clients are increasingly likely to book and plan trips last minute. This trend doesn't seem to be solely or directly linked to climate change but may reflect broader social shift. It can be challenging to pinpoint the specific influence of these factors and understand how they interact with the challenges posed by climate change, making it difficult to fully isolate their impact on the results.

Another important limitation is that this study, by its nature, could not address the long-term impacts of climate change on the profession, particularly regarding the economic viability of the adaptation strategies identified. While the study explored mountain leaders' views on their training, it was not possible to assess the training programs from the perspective of the training providers, limiting a fuller understanding of how current training aligns with the challenges posed by climate change.

Time was a significant constraint. Due to time limitations, certain areas of the data could not be explored as deeply as I would have liked. For example, it would have been interesting to delve into the differences

between full-time and part-time mountain leaders, but the scope of this study only allowed for a brief overview. As a comparison, the survey used in this study was modelled after Mourey's survey for his PhD dissertation, which took four years to complete.

## 4.5 Possible Future Research

There are several potential avenues for future research that could build upon the findings of this study. One interesting area would be to investigate the feasibility of specific adaptation strategies depending on the region. For example, can mountain leaders in the Pre-Alps realistically go higher in altitude to maintain snow-related activities, or are geographical constraints too significant? This could be explored further by comparing different mountain regions to assess the practicality of adaptation strategies.

Another valuable direction for future studies would be to compare the situation in Switzerland with other regions, such as the Canadian Rockies, as was originally intended in this research. While logistical challenges prevented this comparison, it would provide a more comprehensive view of how mountain leaders in different contexts are adapting to similar climate-related issues.

Further research could also examine the economic impacts and viability of the adaptation strategies employed by mountain leaders, particularly focusing on the time and resources spent on reconnaissance and increased planning. Does the added cost of more time spent in planning and recces, for instance, make these adaptations economically sustainable in the long run?

In addition, the data collected in this study could be analysed in more detail, particularly aspects that were mentioned but not deeply explored, such as the emotional impact of climate change on mountain leaders. Understanding the psychological toll of constant adaptation could provide insights into the broader implications of climate change on mountain professionals.

A deep comparison of the survey results from this study with those of Mourey’s study on mountain guides in the Mont Blanc area would allow for a deeper understanding of how the challenges and adaptation strategies differ between mountain guides and leaders.

Lastly, and in my opinion most importantly, future research should look into the current training provided by Swiss mountain leader schools to assess whether it is appropriate and sufficient for preparing leaders to understand and handle the effects of climate change. A detailed analysis of each training program would help identify potential gaps in the curriculum and suggest improvements to ensure mountain leaders are fully equipped with the necessary tools to adapt to a rapidly changing environment.

# 5 Conclusion

This thesis set out to explore the impacts of climate change on the mountain leader profession in Switzerland and to examine the strategies they employ in response. The findings demonstrate that climate change is a tangible force already shaping their daily work. From the increasing unpredictability of snow cover and rising temperatures to the growing frequency of natural hazards like rockfall and landslides, with resulting path closures, the physical environment in which mountain leaders operate is undergoing marked transformation which directly affect their work. These changes also have social and economic repercussions, affecting client expectations, planning and scheduling practices, and the financial viability of their work.

Mountain leaders have responded with an impressive degree of adaptability, in summer more than in winter. The study highlights several key adaptation strategies, including increased time spent planning and conducting reconnaissance, spatial and temporal substitutions, activity diversification, and heightened attention to safety. Furthermore, mountain leaders are actively engaged in efforts to reduce their own environmental impact and to raise awareness among their clients, taking on the role of 'sentinels' of climate change in the mountains.

Importantly, the findings also point to broader structural and institutional challenges. Existing legal frameworks and training programs appear to be lagging behind the realities of the profession, particularly regarding the use of equipment and formal preparation for climate-related risks. If mountain leaders are to continue adapting effectively and safely, it is essential that their legal and educational contexts evolve accordingly. Likewise, client expectations and tourism infrastructure must also adapt to support more flexible and sustainable practices.

This research offers valuable insights into a relatively under-studied group of mountain professionals and underscores the need for future studies to continue building on this work, especially in comparative, economic, and institutional dimensions. As climate change continues to intensify, understanding and supporting the adaptive capacity of mountain leaders will be critical not just for the viability of their profession, but for the sustainability of mountain tourism more broadly.

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# 7 Appendices

## 7.1 Appendix A: Survey

# Mountain Leader's Survey

*As part of my master's thesis in geography, I am studying the effects of climate change on mid-mountain environments and how these changes impact the conditions and activities of mountain leaders. The aim of this questionnaire is to better understand how mountain leaders perceive and adapt to these changes in their working environment.*

***Definitions:***
*The **mid-mountain range** refers in this study to the environment in which mountain leaders are permitted to work, typically between 1,500 and 2,500 meters, below the high mountain or glacial zones.*
***Climate change effects** can be multiple and varied, and can cover aspects such as vegetation changes, shifts in seasonality, changes in weather and precipitation patterns, slope stability, glacial retreat, alterations in animal behaviors, temperature variations, etc. There are no right and wrong answers – I am interested in hearing about the specific changes you experience in your work.*

*The survey will take about 15-20 minutes to complete. The results will be used for academic purposes, and participants' anonymity will be respected.*

*Thank you in advance for taking the time to complete this questionnaire!*

*Hannah Pillon*
*Masters student at the university of Lausanne*

1. Type of Work

1. How many years of experience do you have working as a mountain leader?
*Only one answer possible.*
   - ○ 0-2 years
   - ○ 3-5 years
   - ○ 6-10 years
   - ○ 11-20 years
   - ○ 21 + years

2. In 2024, you worked:
*Only one answer possible.*
   - ○ a single job
   - ○ multiple jobs

3. If you worked in more than one occupation, please specify your other occupation(s):
*Open answer*

4. How many days do you typically work as a mountain leader each year?
*Only one answer possible.*
   - ○ Less than 50 days
   - ○ 51-100 days
   - ○ 101-150 days
   - ○ 151+ days

5. You practise your profession as a mountain leader as:

*Only one answer possible.*

o an independent mountain leader
o an independent mountain leader and member of a company and/or bureau
o an independent mountain leader for a travel agency
o Salaried mountain leader
o Other:

6. Which 3 activities do you lead the most frequently?

*Maximum three answers*
*Several answers possible.*

- Day hiking
- Educational walks (flora, fauna, geology, history)
- Themed workshops (edible plants, spiritual retreats, etc.)
- Multi-day trekking
- Snowshoeing
- Other (please specify):

7. In which 3 months do you spend most of your working days as a mountain leader?

*Maximum three answers*
*Several answers possible.*

- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

8. Which regions or mountain ranges do you primarily work in?
*(Open-ended)*

9. At what altitude do you mostly work at? Select the two zones you spend the most working time in.

*Maximum 2 answers*
*Several answers possible.*

- 0–1000m
- 1001–1500 m
- 1501–2000 m
- 2001–2500 m
- 2501–3000 m
- Above 3001 m

10. What types of groups do you typically lead?

*(Select all that apply)*

- Groups of children
- Families
- Middle-aged/retired adults
- Experienced hikers
- Foreign tourists
- Corporate groups
- Other (please specify):

11. What percentage of your work is with international (instead of resident Swiss) clients?
    - 0-20%
    - 21-40%
    - 41-60%
    - 61-80%
    - 81-100%

## 2. Perception and adaptation to the effects of climate change

*This section is focused specifically on the mid-mountain range, where mountain leaders primarily operate. While you may have experience in high-mountain environments, either in your personal time or as a guide, please base your responses on the terrain relevant to mountain leaders and their work with clients.*

### 2.1 In the summer season (April-October)

*This section focuses on the changes and adaptions during the summer months. The same questions are asked in the following section regarding the winter months.*

12. During the summer season (April-October), have you observed any changes in **mid**-mountain environments that seem to be a result of climate change?

*Only one answer possible.*

- Yes
- No

13. If yes, what are the main changes you have observed? Please state for how long each change has been significant in your opinion.

*Open answer*

14. Do these environmental changes force you to adapt your practices? Only one answer possible.
    - Yes
    - No

15. If yes, in what ways?

16. Is this adaptation:
    1 2 3 4 5 6 7 8 9 10

Easy Difficult

17. Is your profitability affected by these changes in the mid-mountain environments?

Only one answer possible.

1 2 3 4 5 6 7 8 9 10

Not at all A lot

18. Please explain your answer:

*Open answer*

## 2.2 In the winter season (November-March)

19. During the winter season (November-March), have you observed any changes in **mid**-mountain environments that seem to be a result of climate change?

*Only one answer possible.*

- Yes
- No

20. If yes, what are the main changes you have observed? Please state for how long each change has been significant in your opinion.

*Open answer*

21. Do these changes force you to adapt your practices? *Only one answer possible*.

- Yes
- No

22. If yes, in what ways?

*Open answer*

23. Is this adaptation:

1 2 3 4 5 6 7 8 9 10

Easy Difficult

24. Is your profitability affected by these changes in the mid mountain environments?

*Only one answer possible.*

1 2 3 4 5 6 7 8 9 10

Not at all A lot

25. Please explain your answer

*Open answer*

26. Either in summer or winter, have the changes in environmental conditions pushed you to shift the location(s) of your operations to other areas?

*Only one answer possible.*

- All the time
- Often
- Rarely
- Never

27. Do the changes in the mid-mountain environments in response to climate change push you take more risks?

*Only one answer possible.*

- Yes
- No
- Other:

## 2.3 Customers and climate change

28. Do you have the impression that your customers are aware of the effects of climate change on mid-mountain environments?

*Only one answer possible.*

1 2 3 4 5 6 7 8 9 10

Not at all aware Very aware

29. Do you try to make your customers more aware of climate change effects on the mid-mountain environment?

*Only one answer possible.*

o Yes
o No
o Other:

30. If yes, how do you try to increase their awareness?

*Open question*

31. In general, how willing are your customers to adapt their activities in response to climate change effects on the environment?

*Only one answer possible.*

1 2 3 4 5 6 7 8 9 10

Not at all willing Very willing

*32.* How do you feel about changes in mid-mountain environments that seem to be a result of climate change?

→ *Do scalar? From not at all to very strongly, 1 -5.*

- Sadness
- Nostalgia
- Worry
- Optimism
- Perplexity
- Resignation
- Anger
- Curiosity
- Indifference
- Stress
- Fear
- Other:

## 2.4 Mountain Leader Training

33. Have you received any specific training on how to adapt your work as a mountain leader to the impacts of climate change?
- Yes
- No

34. If yes, what kind of training about climate change and its impacts have you received?

35. To what extent do you think future training for mountain leaders should include a focus on understanding and adapting to climate change?

1 2 3 4 5 6 7 8 9 10

Not necessary, current training is sufficient Extremely necessary

30. Please explain your answer:
*Open answer*

## 2.5 Going forward

36. How likely is it that, in the future, climate change and its effects on mid-mountain environments will lead you to reorganise and change the way you practise your profession as a mountain leader?

*Only one answer possible.*

1 2 3 4 5 6 7 8 9 10

Not at all likely Very likely

37. Explain your answer.
*Open answer*

38. Do you see any opportunities that climate change brings?
*Only one answer possible.*
o Yes
o No

39. If yes, what opportunities?
*Open question*

# 3. Your socio-professional profile

40. Age

41. You are:
*Only one answer possible.*
- A woman
- A man
- Other

42. Nationality
*Open answer*

43. Country of residence
*Open answer*

44. Canton/province of residence
*Open answer*

45. What is your highest educational certification?
*Only one answer possible.*

- None
- Primary School Certificate
- Lower Secondary School Certificate ("Certificat")
- Vocational Certificate ("Certificat fédéral de capacité (CFC)"
- Upper Secondary Vocational Diploma ("Diplôme fédéral")
- Professional High School Diploma ("Maturité professionnelle")
- General or Technological High School Diploma ("Maturité gymnasiale")
- 2-Year Post-Secondary Diploma (e.g., Swiss "Brevet fédéral")
- Bachelor's Degree
- Master's Degree
- PhD Degree

## 4. Further information

If you have any comments, suggestions, questions or additional information, please add them below:
*Open answer*

Please enter your email address/telephone number if you would be willing to be contacted for a more detailed interview on this subject:
*Open answer*

Enter your e-mail address if you are interested in the results of this study:
*Open answer*
**Thank you for your response!**

# 7.2 Appendix B: Excerpt of Codification Table

| ADAPTATIONS | | | | | | |
|---|---|---|---|---|---|---|
| Temporal adaptations | | | Activity diversification | | Spatial substitution | |
| **Change dates** | **Adapt timings** | **Cancel** | **Activity substitution** | **Have multiple jobs (especially** | **Plan B** | **Change locations** |
| Extension of summer into the off-season (S44) | In summer, you might have to leave a little earlier, take a break in the afternoon. (7) | I don't cancel. I don't cancel because... I mean, I really try not to cancel. (3) | So it doesn't really impact me, except changes of plan due to weather conditions | So I have a second job. I'm an independant translator. So I decided that I reserve the winter for translation and I limit my activities to the summer season. For me, that was the solution. (2) [to snowshoeing with difficulty) | I think we are trained to adapt. We are trained on what to do if a path is closed. (1) | And I changed my plans last minute because we were going by a riverside and well it was quite dangerous (1) |
| Move the date of some of the tours according to the weather forecast (S18) | Set off in the cool (earlier) on hot days. Plan to take breaks in the shade, and to walk in the shade during the hours when the sun is strongest. Adjust the timing to pass gullies or passes and ridges before thunderstorms. etc. (S10) | Yes, I have done this. Not really, yes, in Grindelwald to a hut. Not an easy way, a little difficult on some places. And then I've seen the days before, it's come rain and thunders and so on. No, we don't go, yeah. (6) | So if there is no snow, we do it without snow. For me for now it is not too bad. (I1) | It's a very interesting job. But maybe you shouldn't only do that. (5) | Plan Bs, well, that's... We've always have them. So, in a... For any type of activity, plan B has to be there. It has to be in the back of your mind, because it's not just to do with climatic factors, but also to do with the people you have. (3) | Usually, when you plan a hike or a multi day hike, either you do it in all weather, or if that is not possible, in the case of the Binntal for example, you change regions. (I2) |
| change of dates for themed walks (S19) | Some stream crossings are only possible in the morning (S86) | No, they don't pay, no. For me also, when I do private, then of course I want to keep the clients. I don't say, hey, you have to pay me for that, my time and I reserved the date and all that. (6) | Well this winter we didn't have outings with snow, well we didn't have outings with snow. Well there are still other outings, just without snow. (I1) | I worked 80% in a company in an office. And hiking guide was the second job, just for fun. Nice money to earn, but not essential... No, you don't count on it to earn your living. (6) | That's it, you have to reinvent yourself, you have to go somewhere else, you have to find something else... There are places where I used to go, even on the big tours, that were plan Bs, but they're no longer plan Bs, you can't go there any more. It's become too dangerous. So does that mean that the financial capacity is reduced? No, because the fact of bouncing back and finding other alternatives, the alternatives are there. (3) | |
| Shift treks to the end of the summer season (S45) | Adapting AM practices to climate change seems more difficult to deal with... if there's no more snow, you move to a region where there is snow, if it's very hot, you shift your timetable, etc... it's still common sense... (S44) | Cancelling trips due to long periods of rain (S36) | I mean, with snowshoes, compared to guides who are on skis, we have the advantage of being able to attach the snowshoes to our bags instead of having to carry all the equipment. (I2) | Today, I focus much more on the summer period. | Yeah, I do adjust routes every time, but I think that's kind of the work we have to do. (4) | I would say in terms of changing locations, you need a bit of flexiblity. Flexibility is linked to practice. For me, it doesn't add a problem, it's basic practice. (3) |
| Set dates differently, e.g. for plant excursions (S74) | | In bad weather, it's easier for groups to cancel... (S34) | More hiking and less snowshoeing (S5) | Yes, it's more predictable, it's much easier to organise, quite simply. What's more, with snowshoes, you often have to go and hire equipment for your customers. It's much easier to just keep the summer season and then take a break for yourself during the winter. (7) | Then I have to plan the whole route with some different things, with what can I do when I don't come through there. I have a plan B, plan C, (6) | At the end of the Val d'Hérens, for example, below the Dixens, there's a really great place where the snow grows as it's so cold . Even now, snowshoeing conditions there are still 'good' compared with many other places where there's no snow at all. So these are places where, if it's too dry on the south side, I say, well, we'll go there. And I've already done that. And as a result, it allows... It's not necessarily the same locations. That's true. (3) |

## 7.3 Appendix C: Excerpt of Codified Interview

l'année, début de l'été. Ça, il me semble que ça fait bien dix ans. Et ça sent pire. Je trouve que ça sent pire. Mais après, je peux me tromper aussi de nouveau.

**[Hannah Pillon]:** Oui, non, mais ça reste subjectif.

**[Interviewee 3]:** Ça reste subjectif, mais je pars plus sur un tour vraiment, fin de saison quand je suis sûr, je fais un tour du Mont-Blanc, c'est sans corde et sans piolet. Mais là, début de saison, je prends toujours. C'était déjà le cas avant, mais là franchement, ça m'est arrivé d'utiliser. Alors que pendant des années, je n'ai pas utilisé le matériel de sécurité. C'est aussi peut-être ça. J'ai répondu ?

**[Hannah Pillon]:** Oui, je crois que oui. C'était juste comment ces changements ont un impact sur votre travail. Peut-être ben vous avez dit prendre plus de matériel de sécurité.

**[Interviewee 3]:** Alors, en tout cas, ne pas l'oublier. C'est-à-dire que là, clairement, sur des moments, oui, ça dépend, mais c'est plutôt en altitude assez haute. Et puis, ce qui a changé, c'est aussi l'information qui passe des fois un petit peu mieux par rapport au chemin fermé ou autre. Là, je pense qu'il y a deux choses. Il y a une espèce de campagne sur-sécuritaire. Généralement, les communes, quand elles sont responsables des chemins pédestres, c'est comme pour les bulletins météo, les bulletins avalanches. Ils sont plus extrêmes, mais j'ai aussi l'impression que ce qu'on se disait il y a encore 15 ans, 20 ans, ça passe. Chacun est responsable de lui-même. Aujourd'hui, on tombe dans du sur-sécuritaire. Non, c'est fermé. Moi je me suis retrouvé sur des chemins fermés, on m'a dit c'est fermé, comment ça c'est fermé ? Je sais très bien que ça passe quoi. Alors je suis passé. Et voilà, le client qui me disait mais sérieux ? Je dis oui sérieux, parce que je sais où on va, on va pas là, là on peut passer, voilà. J'ai une autorisation d'exercice, voilà c'est ma... C'est ma RC aussi, j'ai intérêt à faire juste, mais je pense qu'on va un step au-dessus où je me dis là quand même, ils sont gonflés, ils auraient quand même pu ne pas tout fermer tout de suite. C'est lié souvent à des intempéries, des orages qui cassent des arbres en forêt ou des chemins carrément qui vont être fermés pour l'hiver. Et pour qu'il n'y ait pas d'intervention de sauvetage sur des gens en basket qui n'ont pas allé là-bas, c'est la grosse corde, c'est fermé. Et puis au final, ça passe très bien.

**[Hannah Pillon]:** Merci beaucoup. Et du coup, comment vous avez l'impression que ce soit en été, en hiver, de devoir adapter peut-être votre fonctionnement, peut-être que ça va avoir un peu de chevauchement avec ce qu'on vient de dire, mais parce que du coup, par exemple, de nombreux accompagnateurs ont répondu avoir dû peut-être adapter les itinéraires, réorganiser leur calendrier, et que, par exemple, en hiver, soit les activités sont déplacées en altitude, soit avec des plans B sans neige ou alors annulés. Comment est-ce que vous vivez ? Est-ce que vous devez vous adapter, changer votre mode de fonctionnement ?

**[Interviewee 3]:** Moi, j'annule pas. J'annule pas parce que... Enfin, j'essaie vraiment de pas annuler. C'est les clients qui annulent pour finir. Généralement, ils payent. Parce qu'ils annulent trop tard. Et là, je dis non, quand même, faut pas... Les plans B, effectivement, ça, c'est... On en a toujours eu, hein. Donc, dans une... Pour n'importe quel type d'activité, le plan