

An analysis of the Impacts of Climate Change on Winter Sports in British Columbia

A Case Study of Whistler and Revelstoke, British Columbia

by

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Abstract

Winter sports and tourism are central to Canadian cultural identity and an important economic driver, contributing many benefits including for smaller and isolated communities. It is forecasted that climate change will contribute to an increase in the frequency and intensity of extreme weather events in Canada including flooding, wildfires, avalanches, heatwaves and drought. It is anticipated that the winter sport industry and the tourism industry, in general, will be significantly affected by climate change. Additionally, it is known that the Canadian tourism industry is a significant source of greenhouse gas emissions. Therefore, it is important that stakeholders in the tourism industry understand the environmental impacts associated with their operations. The objectives of this research are to 1) explore the relationships between tourism and climate change in Canada, 2) assess how climate change may impact the industry and 3) explore the strategies that municipal governments and ski resorts are planning to adapt to climate change.

Keywords: climate change; mitigation; adaptation; winter sports; mountain-based resort communities; ski industry

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List of Acronyms or Glossary

| | |
|-------|---|
| BC | British Columbia |
| CECAP | Community Energy and Climate Action Plan |
| CEA | Community Energy Association |
| EV | Electric Vehicle |
| EMS | Environmental Management System |
| GHG | Greenhouse Gas |
| ICSP | Integrated Community Sustainability Plan |
| IPCC | Intergovernmental Panel on Climate Change |
| LGA | Local Government Act |
| NGO | Non-Government Organization |
| OPC | Official Community Plan |
| RMOW | Resort Municipality of Whistler |
| TW | Tourism Whistler |
| ZEV | Zero Emission Vehicle |
| TNS | The Natural Step |
| WBHI | Whistler Blackcomb Holding Inc |
| WCS | Whistler Center for Sustainability |

Chapter 1: Introduction

1.1 Research Rationale

As one of the world's fastest-growing and most significant contributors to the global economy, tourism is particularly sensitive to climate variability and change (UNWTO-UNEP, 2008). This is because the tourism sector relies on consumers who demand to travel to a particular destination, and any unexpected minor changes in the temperature can affect their participation and destination selection. Examples of climate-related challenges impacting the industry include shorter winter seasons, reduced volume of snowfall, unpredictable freeze and thaw cycles, smoke from wildfires, and lower water levels in lakes and rivers (Council of Canadian Academies, 2019).

Yu (2008) groups the potential negative impacts of climate change on the industry into two categories, direct and indirect environmental impact. Climate change could have a direct impact on tourism engagement and destination selection. Aside from the direct impact of climate change on visitor participation and tourism seasonal patterns, climate change may have an indirect impact on tourism by affecting numerous natural resources and infrastructure that the tourism sector relies on (Yu, 2008).

Recent studies on this topic conducted by the World Tourism Organization (UNWTO), the United Nations Agency responsible for the promotion of responsible, sustainable and universally accessible tourism, show that climate change's direct and indirect effects on tourism demand patterns are expected to have a greater impact on many aspects of economic and social policy. Specifically, significant impacts can be expected in areas such as employment and labor demand, housing, transport, and social infrastructure. Other economic sectors, such as

agriculture, handcraft industries, and local small business networks that rely on tourism, may be affected (OECD, 2020).

Tourism is one of the world's largest and fastest-growing sectors, and it contributes significantly to national and local economies (Scott, Lemieux, & Malone, 2011). According to estimates, tourism contributed 10.3% of global GDP in 2019 up from 9.6% in 2008 (Oxford Economics, 2022, Scott et al., 2011). Tourism in Canada is one of the leading national industries that generates business in every region, province, territory, town and community ((Innovation, Science and Economic Development Canada, 2020). By itself, Canada's ski sector contributes around \$839 million to the economy of the country each year (Bruce, 2009). There is no doubt that climate variability and change will affect the economy as well as the environmental conditions of some destinations like mountains, ski resorts, and alpine skiing even more than other areas due to higher sensitivity to warming weather (Moen, 2007). Therefore, it is important to pay extra attention to these areas as their continued operation and existence are critical for both the economy and the environment.

Furthermore, a recent report by UNEP/UNWTO (2008) identified the links between tourism and climate change. Some of its key conclusions are that carbon dioxide emissions from tourism activities (transport, accommodation, activities) account for 4 to 6% of total emissions worldwide. This report estimates that if mitigation measures are not implemented, tourism's contribution to carbon dioxide emissions could grow by 150% in the next 30 years (UNWTO, 2008).

1.1.4 Global Warming and Mountain-Based Resort Communities

To attract visitors and retain/increase resident populations, mountain-based resort communities and their accompanying ski resorts rely on suitable alpine weather and climatic

conditions and easily accessible natural resources (Scott, 2003; Williams, Dossa, & Hunt, 1997). However, the Intergovernmental Panel on Climate Change (IPCC) indicates that anthropogenic greenhouse gas (GHG) emissions are threatening global climate stability and the availability of snow cover for many alpine winter tourism activities (IPCC, 2022b).

Since the late 1940s, the average annual temperature in Canada has risen by 1.1 degrees Celsius, with winters undergoing the most warming—on average, they are 1.9 degrees Celsius warmer (Bruce, 2009). In BC, the province warmed dramatically during the last century and variations in the tourism season length and type of precipitation—primarily more rain and less snow—are visible (Walker & Sydneysmith, 2008). These effects influence the natural winter setting of BC's alpine regions (e.g., receding glaciers, lower snowpack, and less dependable snow cover), limiting the appeal of ski tourist activities in these places (Walker & Sydneysmith, 2008). This necessitates the implementation of climate change response plans in conjunction with sustainable development goals by both local governments and ski resorts (Scott, 2010; UNWTO & UNEP, 2008). For the purpose of this research, I used a climate change response frame adapted from Jopp et al. (2010) to understand how the Resort Municipality of Whistler (RMOW), Whistler Blackcomb Inc. (WB), Revelstoke Mountain Resort and Mount Mackenzie are developing climate change management initiatives alongside sustainability strategies in Whistler and Revelstoke British Columbia. The findings are educational for mountain-based resort towns and ski resorts' municipal governments.

1.2 Research Approach

Although the impacts of climate change on tourism have been widely recognized and research relevant to this subject was initiated more than 10 years ago (Scott,

McBoyle and Schwartzentruber, 2004). To date, studies dedicated to measuring the impact of climate change on the tourism industry, specifically winter sport and its demand drivers are limited and sparse (Freitas, Scott, and McBoyle, 2004). Among the reasons for this are complexities in developing appropriate tools for measuring tourism-related climate resources and quantifying the climate/tourism relationship.

1.2.1 Methodology

The methods used are three-fold—1) a literature review of the current situation, 2) case studies and 3) interviews. The literature review examines studies into how climate change affects tourism, how to prepare for climate change in mountain resort communities (Whistler and Revelstoke), and whether the resorts are prepared for the challenges in the coming years (mitigation and adaptation).

The two case studies evaluate how the Whistler and Revelstoke ski resorts are preparing for climate change using an adaptation of Jopp et al. (2010) 's regional adaptation model. Finally, semi-structured interviews were conducted with program managers, tourism employees, non-governmental organizations (NGOs), ski resort operators, and other tour operators. The case study's empirical findings were systematically analyzed and reported following themes in Jopp et al.'s (2010) regional adaptation model adaptation.

1.3 Thesis Organization

There are five chapters in this thesis. Chapter one is an introduction to the research; this chapter defines the goal of the research and explains the relevance of the findings. Chapter two examines and explains previous research on the topic, not just in terms of previous discoveries but also in developing a theoretical framework on which to base my research. The third chapter

explains and justifies the data collection procedures and identifies the study constraint/limitations. Chapter four addresses the results /reports of my data analysis and case study findings. Chapter 5 details the finding from interviews with personnel from the two resorts. Chapter 6 discusses conclusions, implications, limitations, and recommendations for future/further studies.

Chapter 2: Literature Review

2.1 Introduction

This literature review provides contextual information about the impacts of global warming on mountain-based resort communities. This chapter is compiled from multiple articles and papers and scientific studies which have influenced this study. In order to develop a better understanding and build a roadmap for the study, this section is divided into two parts.

1. The impact that climate change might have on winter-based tourism, mountain-based communities, and ski resorts.
2. The planning model for climate change in mountain-based tourism such as governance, mitigation, and adaptation strategies.

2.2 Tourism and global warming

2.2.1 Tourism

World Tourism Organization (WTO, 2008) defines tourism as “when individuals travel and stay in areas other than their usual environment/surroundings for less than one consecutive year for leisure, health, business, or other purposes” (P. 81). Tourism was one of the largest industries in 2019, accounting for 10.4% of global GDP (USD 9.2 trillion), 10.6% of all jobs

(334 million), and one out of every four new jobs created globally (WTTC, 2011). The tourism industry as a whole is difficult to evaluate since, unlike other businesses, it does not have a single product. It comprises a wide range of enterprises, including lodging, transportation, travel agencies, and attractions.

Furthermore, in 2019, foreign visitor expenditure totaled USD 1.7 trillion, representing 6.8% of total exports 27.4% of global services exports (WTTC, 2021). However, the tourism industry was severely impacted by the global COVID-19 pandemic that began in early 2020. The tourism industry has lost over USD 4.5 trillion due to COVID-19 and continued limitations on international mobility. Its worldwide contribution to GDP decreased by 49.1% from 2019 to just USD 4.7 trillion in 2020, compared to a global GDP reduction of 3.7%. Domestic tourist expenditure declined by 45 percent, while overseas visitor spending dropped by 69.4% (WTTC, 2021).

Tourism is a vital aspect of the Canadian economy, providing jobs and stimulating economic growth in every province. It produces about CAD 100 billion in tourism expenditure each year, accounting for 2.1 percent of Canada's GDP and 3.1 percent of total exports. It directly supports 739 700 jobs or 3.9 percent of overall employment. In 2018, travel exports accounted for 26.6 percent of overall service exports. In 2018, Canada attracted a total of 21.2 million overseas visitors, an increase of 1.2 percent over 2017 (OECD, 2020).

2.2.2 Climate Change

The United Nation Framework Convention on Climate Change (UNFCCC) signed in 1992 defines climate change as “a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (Article 1)”.

According to all of the IPCC reports since 1995, there is mounting evidence from various natural systems that global climate change is occurring. The most recent report in 2022 provided further evidence of climate change and its impact across the world (IPCC, 2022). Eleven of the previous twelve years are among the top twelve warmest years in the global surface temperature record since the 1850s (IPCC, 2022). The recent rising trend (0.13°C each decade) is approximately double that of the previous 100 years. Sea level rise has been aided by widespread melting of glaciers and ice caps, as well as rising ocean surface temperatures (Scott et al., 2008). Between 1961 and 2003, the global average sea level increased at a rate of 1.8 millimeters per year, and between 1993 and 2003, it climbed to around 3.1 millimeters per year (Scott et al., 2008). The biological reaction of ecosystems and individual species has been documented on every continent. It is worth noting that impact assessment studies in the tourist sector aren't always inferior to those in other industries (UNWTO-UNEP, 2008)

According to the Intergovernmental Panel on Climate Change (IPCC), the warming of the climate is non-negotiable (IPCC, 2021). The average temperature globally rose by 0.76°C between the years 1850 to 1899 and 2001 to 2005, and the IPCC between 1850 and 1899, the global average temperature increased by 0.76°C . The IPCC concluded that the majority of the observed increase in global average temperatures since the mid-20th century is very likely (> 90% probability) due to human activities that increase greenhouse gas (GHG) concentrations in the atmosphere. With ongoing GHG emissions at or above present levels, the IPCC (2022) estimates that the speed of climate change would increase, with globally averaged surface temperatures rising by 1.8°C to 4.0°C by the end of the century.

The tourism sector is expected to have to adapt to varying temperature changes and other climatic features globally (IPCC 2007b). Extreme hot temperatures, heat waves, and high

precipitation levels are predicted to become the norm. Certain regions in the world have already experienced snow cover reductions and the trend is expected to continue. These catastrophic events have already impacted many popular tourist destinations, and the lists of these destinations are expected to grow. These anticipated changes underline the importance of raising local knowledge and readiness for natural hazards and incorporating measures to improve disaster risk management capabilities and agility for change (UNWTO 2007b).

Bruce (2009) concluded that the future of winter sports in Canada is at risk due to global warming and provided insights into the significance of winter sports stakeholders can take action on climate change and begin to adapt to the changes in Canadian winters already underway. According to the author, if we do not take immediate action on climate change, a wide range of winter activities in Canada, including Olympic sports like skiing and snowboarding, as well as traditional Canadian activities like ice fishing and pond hockey, would be endangered by 2050. He believes that by building a national climate change action strategy for Canada's winter tourism and ski sector, we may promote government climate change policies as well as business solutions, including mandated renewable energy objectives. Furthermore, adaptation measures and future low-carbon strategies can protect Canada's winter sports (Bruce, 2009)

2.2.3 Mountain Regions

Mountain areas are well-known tourist destinations all across the world. Snow cover and spectacular alpine landscapes are the key tourist attractions in these areas, and they are among the features most vulnerable to climate change (UNWTO, 2008). Over the years, several kinds of research have been conducted to explore and provide evidence of the detrimental influence of global warming on glaciers and mountain meadows, particularly in the lower to mid-elevation compared to higher elevations (Scott, 2003; UNWTO, 2008). Impacts associated with climate-

related change include increased rainfall and decrease in the snowfall during the winter, rising risk of an avalanche due to snow melting and grooming, and interruptions in the length of fall and spring seasons (Bruce, 2009; IPCC, 2019).

2.2.4 Climate Change Impacts on Mountain-based tourism

Tourism and climate change interact in a variety of ways. In the first instance, the climate is a tourism resource and an essential component of the tourism product and experience. At the same time, the climate puts tourism in danger and can significantly threaten the industry. For example, weather conditions in British Columbia may restrict tourists from participating in their chosen activities due to climate variability. In this case, skiers and winter sport tourist seekers will be affected negatively due to low or no snow, as well as dangerous and unpredictable weather conditions.

Winter sports have influenced Canada's culture and helped build many of its traditions. According to most Canadians, one of our country's defining national emblems is hockey (Keating, 2010). Many Canadian towns and rural areas rely on winter sports and tourism as a source of revenue. There are more than 235 ski resorts in Canada and over two million Canadians ski or snowboard annually (Canadian Ski Council, 2018). The ski and snowboard industry tourism brings in \$1.2 billion annually (DellaCamera, 2021). Furthermore, warmer temperatures, caused by the accumulation of heat-trapping emissions in the atmosphere, will have a significant impact on ice and snow which will result in shorter winter seasons, a shrinking area of snow cover, a shift in snow lines up mountainsides, and reduced water supplies due to less summer runoff into rivers and streams. The length and quality of the winter leisure seasons, as well as the diversity of winter athletic activities accessible, are all threatened by global warming (Bruce, 2009; DellaCamera, 2021).

Scott et al. (2017) discussed the importance of ski and mountain tourism to the economy of Canada. In this article, the authors used a ski simulation model, called SkiSim version 2, that incorporates snowmaking into the natural snowpack in all 34 alpine ski regions in southern Ontario (Canada) to record and assess any changes in the capacity of this regional marketplace. The study's findings show that climate change has altered the function of all 34 alpine ski areas. These changes include 1) a decrease in ski seasons, 2) an increase in interannual variability and 3) controversy between the demand and supply for snowmaking. It also notes that climate change mitigation policy over the next 20 years and the results of emission pathways will influence the future of ski tourism in this region. If the international community achieves the Paris Agreement's objective (2°C), system capacity losses can be kept to less than 10% by the middle to late century (Scott et al., 2019). On the other hand, a high-end emission scenario will disrupt the ski tourism sector by mid-century, with system capacity losses between 28% and 73%.

2.2.6 Climate Change Vulnerability and Ski Resorts

Scientists have noted that the global mean temperature has increased by between 0.6 and 1 degree Celsius over the last century (IPCC, 2018). But over the next 100 years, greenhouse gasses are expected to boost the world's temperature by 1.4 to 5.8 degrees Celsius, according to the Intergovernmental Panel on Climate Change (2016).

Several articles and literature on mountain-based sports indicate the vulnerability of the ski resort and winter sport to the impacts of climate change. The vulnerability of ski resorts and winter tourism relies on elevation, snow reliability, and degree of base development (Bruce, 2009; Scott, 2003; Scott et al., 2009; UNWTO & UNEP, 2008). These changes impacted by

global warming can cause a reduction in visitors due to poor quality of weather, shorter ski seasons, and lower snow levels.

2.3 Planning for Climate Change in Mountain-Based Resort Communities

2.3.1 Governance

The values, regulations, institutions, and procedures through which public and private parties' endeavor to attain common goals and make choices are described as governance (Beritelli, Bieger, & Laesser, 2008). Tourism-based communities face unique governance difficulties that need equally novel strategies to address their context. The policies, which are frequently crafted at the regional level, must serve two purposes: they must provide the community with the legislative tools it needs to craft and manage a sustainable and competitive tourism product, and they must also make it easier for residents to create and maintain a desirable and livable community. In a tourism community, both notions are frequently intertwined: the town's identity may become a consumable image for visitors, while the tourism product—the image and experience—can often influence a community's identity (OECD 2012). Nonetheless, the policies in question must meet both requirements. The problem reflects the binary character of tourist-based communities, which must function as a tourism product and a community. This duality must be reflected in local policy, for example, the lack of accommodation for seasonal employees.

Tourism governance systems cover development, planning, policy actions, and ways to allocate resources, exercise control, and coordinate activities (Bramwell and Lane, 2011). They also show how government and non-government organizations collaborate (Bramwell, 2011). Governance encompasses various activities, power structures, objectives, and institutional links.

Resort governance systems do not develop out of thin air; pressures and the will of individuals shape them. They are exposed to shocks and pressures throughout their lives, and there are many forces used to enact change or maintain the status quo. This study aims to learn more about the link between resort governance and these different factors.

According to a conceptual model of change in resort governance by Gill and Williams (2011b), distinct lock-in mechanisms limit change and encourage path dependency. A lock-in is a self-reinforcing mechanism that functions through a succession of positive feedback loops. Martin (2009) emphasizes that lock-ins should not be interpreted as implying stability and stagnation (which would be contrary to the evolutionary paradigm). Instead, lock-ins limit the options accessible relative to those available at a previous time (Sydow, Schreyogg, and Koch, 2005). The Gill and Williams (2017) approach, based on Grabher (1993), identifies three distinct lock-in mechanisms: structural, political, and cognitive. These can be used separately or in conjunction with one another. Available feedback loops such as sunk costs or transition costs focus on structural lock-ins. Institutional embedding is linked to cognitive lock-ins (Gill and Williams, 2011). Finally, political lock-in refers to powerful institutions with a vested interest in maintaining the status quo and are resistant to change (Schienstock, 2004). The model explains how prominent individuals and structures' objectives, interests, and culture can often stymie progress.

Gill and Williams (2017) also described the path construction mechanism in their model. It specifically finds processes capable of challenging the status quo, unlocking current paths, and/or facilitating the formation of new ones. The model emphasizes four factors that have been found in the literature and confirmed in their research. The four categories are agency, real-time

influences, exogenous events, and endogenous events. Entrepreneurial individuals can deliberately employ these factors to help impact new routes, according to the authors.

The model proposed by Gill and Williams (2017) is a suitable framework for the study. The use of path dependency and path creation forces in a resort governance system gives a useful overview of the dynamics of change. Unlike Gill and Williams (2017), this study will not seek to define or categorize resort governance systems; instead, it will concentrate on the factors that cause change.

2.3.2 Climate Change Response Strategies

Tourism is a complex and non-linear business with numerous players representing diverse sectors, local entrepreneurs, non-tourism organizations involved in transportation, insurance as well as governmental and non-governmental institutions. Since tourism touches so many parts of the economy, adaptation and mitigation plans must be considered as a joint endeavor, including all key stakeholders in the tourist industry. Mitigation and adaptation are two types of interventions or responses aimed at reducing climate-related hazards. Mitigation "is the promotion of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere" (IPCC, 2007b, p. 818). While adaptation is an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007b, 2021).

There are several significant contrasts between adaptation and mitigation, particularly in terms of their goals. Climate change mitigation focuses on the causes of climate change (the buildup of greenhouse gases in the atmosphere), whereas climate change adaptation focuses on the effects of climate change. The tourism industry needs both strategies to survive and combat

the impacts associated with climate change in the near and distant future. Existing information and research show and predict the negative impact on tourism might be significant, and that is where mitigation would be beneficial. Mitigation strategies would be crucial in minimizing the risky and devastating impacts. However, only relying on mitigation is not enough and is too risky for the sector, which is why winter-based tourism needs to adopt strategies and new techniques to survive and reduce the negative impacts and still be able to exist and run in the future.

Mitigation

"To limit global temperature, rise to below 2°C aiming for 1.5°C, as promised in the Paris Agreement, countries must cut 30 gigatons of GHG emissions annually by 2030 (IPCC, 2007, 2021). The necessary solutions exist yet currently more emissions are entering the atmosphere making it harder to keep the planet safe" (UNEP, 2018). Therefore, many organizations and businesses are encouraged to embrace carbon neutrality. Carbon neutrality refers to the full set of policies that an institution or organization employs when calculating known GHG emissions, implementing mitigation measures, and purchasing carbon offsets to 'neutralize' leftover emissions (Simpson et al., 2008). Government leadership and action are required to shift away from the use of fossil fuels and other behaviors that are causing our climate to deteriorate but we can all make a significant contribution. Everyone can minimize greenhouse gas emissions and carbon footprint from everyday activities by changing some of their old habits such as driving and flying less, buying energy-efficient equipment, making buildings more efficient, and utilizing renewable energy. These small changes may considerably impact lowering GHG emissions, but they are insufficient to reduce GHG emissions to zero. (David Suzuki Foundation & Pembina Institute, 2009).

The David Suzuki Foundation and the Pembina Institute collaborated on a study to assist the Canadian government and businesses in developing sustainable solutions. One option for reducing the residual climate effect is to pay for greenhouse gas reductions to be done elsewhere. This is known as "carbon offsetting." It requires investing in projects such as wind farms, tree planting, and landfill gas recovery systems that reduce, eliminate, or eliminate harmful greenhouse gas emissions.

In summary, mitigation may be accomplished through lowering energy use, for example, by modifying travel habits, improving energy efficiency, increasing the use of renewable energy, and implementing carbon offsetting schemes. There are four primary strategies to consider: reducing energy usage, improving energy efficiency, leveraging renewable energy solutions, and, last but not least, the purchase of carbon offsets, all of which are indicated as primary mitigation methods for reaching a net carbon footprint of zero (Simpson et al., 2008 & David Suzuki Foundation & Pembina Institute, 2009).

The winter-based tourism industry and mountain-based resort communities include a diverse range of businesses, ranging from small, local operations that cater to a single local market to extensive transportation, hotel, and tour operator. Therefore, they need to recognize the importance of skiers and visitors in generating commercial interest in sustainable tourism goods; the industry is looking at mitigation methods and becoming more proactive in tackling climate change. As customers become increasingly conscious of tourism's connection to climate change, the industry focuses more intently on developing measures to become carbon neutral (Simpson, et al., 2008).

Due to technical, economic, and social constraints, the uptake of mitigation strategies in mountain-based resort communities and ski resorts appears to be restricted. Transportation is by

far the most important contributor to tourism-related greenhouse gas emissions, and aviation is the most important sub-sector within transportation. The voyage to the destination is projected to contribute 60-90 percent of the trip's overall impact to climate change for the bulk of air travel journeys (Gössling et al. 2005).

Adaptation

"Adaptation is a process by which strategies aiming to moderate, cope with, and take advantage of the consequences of climate events are enhanced, developed and implemented" (Simpson., et al., 2008). According to Jopp et al. (2010) "it is the principal way to deal with the unavoidable consequences of climate change". Multiple literature reviews and two comparative case studies were conducted for this study, and they explain various sorts of tourist sector adaptations (Simpson., et al., 2008, IPCC, 2021). Furthermore, Simpson identified various adaptation strategies including technical adaptation, business management, and behavioral adaptation to address climate variability at the destinations.

2.4. Case Study Background

2.4.1 Project scope

Although there is a wealth of existing research and literature on the impacts and mitigation of climate change, there is limited coverage on the topic for the tourism industry and, more specifically, the winter-based sport subsegment. As Canada's winter sports attract many domestic and international tourists worldwide, it is an important topic and should be thoroughly investigated. Therefore, the aim of this study is to examine the potential effects that climate change may have on the winter-based tourism industry by focusing on the ecological and

physical systems of alpine winter sports in Canada and by identifying whether the industry is ready to deal with the projected changes/ challenges, as well as, any mitigation and adaptation strategies for the changes resulting from climate imperatives.

According to Moen and Fredman (2007), multiple studies have shown that mountain-based tourism, especially snow sports like alpine skiing, may experience significant negative impacts of changing climate sooner than what scientists two decades ago anticipated. Moen and Fredman (2007) have found that “future climate change may have significant negative effects on both ski season lengths and associated economic impacts” (p.433).

The objectives of this research are to assist stakeholders, municipal governments, and mountain-based ski resorts to identify the mitigation and adaptation techniques they need to take into consideration given the significance of tourism in Canada's economy and a continually growing sector.

2.4.2 Whistler, BC

Whistler Blackcomb is a ski resort in the Squamish-Lillooet Regional District (Canada, British Columbia, Vancouver, Coast & Mountains). There are 200 km of slopes and 50 km of ski paths for skiing and snowboarding. The winter sports area is located between 675 and 2,284 meters above sea level. Whistler Mountain and Blackcomb Mountain are the two mountains that make up the Whistler Blackcomb Olympic ski resort. The Peak 2 Peak gondola connects the two mountains and Canada's largest ski resort, with slopes for all skill levels (Skiresort.info, n.d.)

Whistler is a completely designed four-season mountain resort city, the official site of the 2010 Winter Olympic and Paralympic Games. It is located 120 kilometers north of Vancouver, and it has become a top international resort that has been recognized as North America's premier mountain destination since its existence over 35 years ago (Whistler 2020, 2011, Gill &

Williams, 2011). The resort alone attracts around two million tourists each year, with a permanent population of around 11,000 people (Whistler 2020, 2011, Gill & Williams, 2011). Non-residents own nearly half of all residential properties, and the destination alone produces 25% of the province's tourism earnings (Gill & Williams, 2011a). The Resort Municipality of Whistler Act of 1975 established the RMOW as a resort municipality. The four-season resort corporation Whistler and Blackcomb Holding Inc. (WBHI), whose activities are principally centered on two mountains that border the municipality, Whistler, and Blackcomb, is the significant employment and largest enterprise of Whistler. Downhill mountain biking and sightseeing are the main draws in the summer, while downhill skiing and snowboarding are the keys to the winter (Whistler 2020, 2011). Summer visitors tend to come from regional markets and remain for a shorter period, whereas winter visitors tend to come from destination markets and stay for more extended periods. Whistler's primary tourist season is winter, which accounts for most of the resort's earnings (BC Stats, 2005). The capacity of the RMOW and Whistler Blackcomb Inc. to keep tourism as a core economic engine is critical to their survival (Whistler 2020, 2011).

The RMOW recruited KPMG, an economic consulting firm, in 2000 to figure out how much Whistler contributes to BC's income stream overall. Whistler's resort economy was predicted to produce \$1.035 billion in tourism expenditure, accounting for 11% of the province's total tourism income of \$9.47 billion, according to KPMG. Whistler's direct tourist expenditure was anticipated to be \$921 million in that same year. Food and beverage accounted for over a third of this (30%), with the hotel (25%), recreation and entertainment (15%), retail (14%), grocery (7%), and transportation accounting for the remaining 7 percent. Although the KPMG research needs to be updated, Whistler's proportional contribution to BC's tourism income is still

projected to be about 11%. According to BC Stats (2008), around 30% of Whistler's occupations are in the hotel and food business, 10% in entertainment and leisure, 9% in retail, and 9% in construction.

Both the RMOW and Whistler Blackcomb Inc. recognize the importance of protecting and conserving the area's natural resources for visitors and residents. They have made a solid commitment to developing economic, social, and environmental actions that will improve the destination's overall sustainability.

The RMOW established a community-driven model of government in 2000, influenced by the "The Natural Step" (TNS) sustainability principles (Gill & Williams, 2011; Whistler 2020, 2011). Its principles are intended to guide collective community decisions toward actions that eliminate the gradual accumulation of substances extracted from the Earth's crust, the gradual accumulation of chemicals and compounds produced by the community, the gradual physical degradation of nature and the ecosystem. The Whistler 2020 vision states that "Whistler will be the top mountain resort community – while we strive toward sustainability" (Whistler 2020, 2010).

Whistler Blackcomb Holding Inc. (WBHI) had started on its path to sustainability prior to the RMOW's strategy. The ski resort created an environmental management system (EMS) plan in 1992, which now complements the RMOW's Whistler 2020 strategy and includes a zero operational footprint objective for trash, carbon, and net emissions.

RMOW developed a Community Energy and Climate Action Plan in 2016 to address both what can be done to reduce carbon footprints and how to adapt to climate change that is already occurring and expected to increase in the near future. This demonstrates how carefully the municipality measures its carbon footprint and GHG emissions.

RMOW in 2020 prepared the Climate Action Big Moves Strategy that focuses on climate change mitigation goals that will help Whistler expedite climate action and reduce greenhouse gas (GHG) emissions significantly. It builds on the Community Energy and Climate Action Plan (CECAP) work from 2016 and supports the Official Community Plan (OCP). This approach serves as a roadmap for prioritizing and categorizing CECAP measures, taking advantage of new possibilities, and coordinating community-wide efforts to achieve significant emissions reductions.

Climate Action Big Moves are concentrated on the transportation, building, and waste sectors. Whistler's emissions are mostly caused by vehicle transportation and the built environment. Whistler's most major source of GHG emissions is personal transportation, which accounts for 54 percent of total emissions in 2019. Buildings have reduced emissions by 6% since 2007, although they still account for 38% of total emissions in Whistler, with natural gas from commercial buildings accounting for 24% and residential buildings accounting for 11%. Even though the waste sector has been Whistler's best performer, reducing emissions by 90% since 2005, it is included in this strategy to be consistent with other Big Moves projects and to emphasise that more can be done. The RMOW stated that it is an ambitious proposal that will bring them closer, but not quite there, to fulfilling their current GHG reduction goals and the IPCC target of a 45 percent reduction in GHG emissions by 2030 compared to 2010 levels (Big Moves: Our 2030 Target, 2021).

The municipality is also working towards awareness and adaptability to take advantage of new possibilities since creative thinking and efforts will be required in the coming years to reduce the gap, including increased assistance and instruments from other levels of government to aid future municipal action.

2.4.3 Revelstoke, BC

The Columbia-Shuswap Regional District is home to the ski resort Revelstoke Mountain Resort (Canada, British Columbia, Kootenay Rockies). There are 55 kilometers of slopes for skiing and snowboarding. The guests are transported through seven lifts. The winter sports area is located between 512 and 2,225 meters above sea level. The Revelstoke Mountain Resort is situated on the British Columbian slopes of Mount Mackenzie (2,456 m) (Ski resort.info, n.d.).

The winter sports resort is located on the Trans-Canada Highway about 6 kilometers southwest of Revelstoke. The ski resort is well-known for having the largest lift-accessible vertical difference in North America - 1,713 m - The ski resort has well-groomed slopes for all degrees of difficulty. For expert skiers, there are a variety of glades and bowls with unprepared powder routes and helicopter and cat skiing. Beginners may practice in the base area, while freestylers can have fun in the snowpacks. A snow tubing area adds to the pleasure. The Revelstoke Mountain Resort Village, located right at the winter sports resort, offers ski-in/ski-out accommodations (Ski resort.info, n.d.).

Revelstoke's economy is based on transportation and mining supply activities, wood, and tourism, and it was founded in the 1880s. The community was boosted by constructing three neighboring dams beginning in 1965. When dam construction was completed in the mid-1980s, and the economy slumped, Revelstoke began planning and executing programs to help the economy recover (Nepal & Jamal, 2011). Backcountry skiing, heli-skiing, Cat-skiing, snowmobiling, hiking, mountain biking, and other adventure sports shaped the mountain culture. Mount Revelstoke (1943 m) and Glacier National Park are close to town. Mt. McKenzie (2143 m), which at the time was only a community ski slope, was recognized as a key for development. The first resort phase of the Revelstoke Mountain Resort, renamed the Revelstoke Mountain Resort, was finished in 2007. Revelstoke has had the biggest absolute number of amenity

migrants, peaking in 1992 (>350 persons), falling somewhat in 2006 (>270 people), and continuously climbing since 2004. (Nepal & Jamal, 2011, Pacific Analytics Inc. 2009).

Chapter 3: Methodology

Although the impacts of climate change on tourism have been widely recognized and research relevant to this subject was initiated more than 10 years ago (Scott et al., 2004) studies quantifying the impacts of climate change on tourism and specifically tourism in Canada remain limited, most likely due the multifaceted nature of climate and the complex ways in which climate elements combine to shape the weather conditions that affect tourism (Freitas et al., 2004). One of the most challenging problems is to develop appropriate tools for measuring tourism-related climate resources and impacts, as well as quantifying the climate/tourism relationship.

3.1 Case Study Selection

According to Yin (2008), case study research involves a detailed analysis of a specific event, location, item, organization, or unit. Typically, a case has a defined space and time frame: "a phenomenon of some sort in a bounded context. "Case study research is an in-depth investigation of a recent occurrence in its natural setting. Case study research has gained a reputation as a useful tool for investigating and comprehending complex topics in real-world situations.

Yin (2004) and Stake (2005) explain that the case study method is most often described as qualitative inquiry that involves the use of multiple sources of information such as primary and secondary data: interviews, articles, journals, reports, government websites (Stake, 2006; Creswell, 2014 Yin, 2004). A case study explores a bounded system by which the main objective

is to understand what is happening inside that bounded system. The core strength of the case study method is the depth of investigation involved with collecting individual narratives from case study participants. Using the case study method, the relationship between multiple stakeholders and interested parties related to climate change planning and strategy was examined. It also allows the researcher to investigate human subjects' behaviors, perceptions, and experiences in a specific place-context (Yin, 2009), such as Whistler and Revelstoke in British Columbia (BC).

This research leverages a mixed methods approach to explore the changes in the winter sports industry due to climate change and to discover possible mitigation strategies. The mixed methods research incorporates collecting, analyzing, and mixing qualitative and quantitative data within a single study (Creswell, 2005). According to Johnson et al. (2007), "mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e. g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroborated" (p. 123). Regarding the main strengths, the key purpose of mixed methods study is that integrating both quantitative and qualitative approaches in combination may provide a better understanding of research problems and complex phenomena than each approach by itself (Creswell and Plano Clark, 2007). We can further verify our understanding of the information by triangulating one set of results with another and enhancing the interface's validity.

Moreover, this study involves both descriptive and exploratory research approaches. Jupp (2006) defines exploratory research as "a methodological approach primarily concerned with discovery and generating or building theory. In a pure sense, all research is exploratory. In the

social sciences, exploratory research is wedded to the notion of exploration and the researcher as an explorer. In this context, exploration might be thought of as a perspective, a state of mind, a special personal orientation' (Stebbins, 2001, p.30) toward approaching and carrying out social inquiry".

3.2 Data Collection

Research methods or tools are critical for any research study to generate and analyze the data we need to answer the questions. This section of the study addresses the essential two data collection methods used throughout this project and the advantages and disadvantages of each of them. The primary data collection was gathered between April 2021 and July 2021 through a series of interviews with community stakeholders, including municipal employees, avid skiers and brand representatives, NGOs, hotel management, and tourism sector operators. In addition, secondary data was gathered from various sources, including websites, journal articles, annual reports, and government documents.

3.2.1 Interview Strategy: In-Depth Semi-structured

Using qualitative research interviews is appropriate for this study due to the exploratory nature of the topic, where individual perceptions of processes within an organization are to be studied (Robson, 2002). The primary data collection is collected through in-depth semi-structured interviews (Holstein and Gubrium, 1995) to assess various issues surrounding climate change impacts on Canada's tourism industry. According to Oakley (1998), "qualitative interview is a type of framework in which the practices and standards are not only recorded but also achieved, challenged and as well as reinforced"). Due to the exploratory nature of the topic, qualitative research interviews are the most appropriate data collection as various experts' and

stakeholders' inputs need to be studied to determine better the impact of climate change in winter sport tourism and adaptation models (Robson, 2002).

Interviews are a good way to gather facts and information. Interviews are one of the essential sources of information for the case study, according to Yin (2003). The goal of interviews is to describe and comprehend the experiences and opinions of key informants as they are expressed verbally (Kvale, 1996; Creswell, 1998). The researcher's job is to figure out why the key informants feel and act the way they do (Kvale, 1996). This study picked and performed the interview strategy for two main reasons. First, the interviews are designed to acquire a better knowledge of the present situation in winter-based tourism and ski resorts debate from a variety of perspectives and experiences. Second, the interviews are meant to provide insight into the case study's objective and questions to better understand their readiness in addressing climate change.

In-depth semi-structured interviews were conducted with key informants who were chosen to represent a diversity of views and realities from academia, environmental non-governmental organizations, governments, and the ski resort industry. A key informant's viewpoints are more likely to be expressed in a semi-structured interview versus a fully structured interview (Flick, 2002). In reflection of the diversity of key informants, the case study contacts, and sustainable ski resort discussion contacts were further subdivided into key informant categories according to organization type. Here, interview questions were adjusted to match each key informant's organizational affiliation and job responsibilities with the intent of addressing the knowledge area each key informant was most familiar with.

Interviews are a good method as they require perspectives into the significance of different predictive models and the interpretations of the data. Roulston and Choi (2018) argue that using interviews as a single method can be problematic, as it has been demonstrated that

people are subject to forgetfulness and remember events based on their feeling, setting, and how they felt when they were asked questions. Therefore, it is not logical to only rely on interviews as a tool for generating facts and valuable information. Further, in interviews, participants represent themselves differently based on the social settings and audiences to whom they are speaking (Roulston & Choi, 2018). Therefore, it is recommended to use multiple data sources and secondary data to increase the validity and reliability of the research.

3.2.2 Participant Selection and Recruitment

Research participants included stakeholders, individuals who work in the tourism industry, NGOs, municipal representatives, and ski/hotel operators. Because of the Covid-19 pandemic, the data gathering for the study had limited/restricted options in conducting interviews. Therefore, the interviews were conducted using zoom meetings and skype over phone calls due to advantages such as the ability to observe the participants' facial expressions, as well as their body language, which can increase the accuracy and provide more useful data.

The participants were provided with a series of questions and consent forms prior to the meetings. They were asked to read the material and sign the consent form prior to the interview. All participants who participated in this study were voluntary and were given the option to withdraw if needed at any time within the process. The series of questions were designed using materials and documents which were approved by the committee before being given to any participants. During the interview process, the participants were audio-recorded and transcribed later. Once transcribed, the data were analyzed based on the guiding themes of the assessment and interview guide.

Another key point in gathering data was the interview selections. In order to avoid biased or not accurate information, the participants were selected systematically rather than randomly, a purposeful sample (Moser, 2018) in order to get an overall perspective from key actors.

3.2.3 Interview Process

Table 1: *Distribution of respondents by organization*

| Participants | Organization | Whistler # of participants | Organization | Revelstoke # of participants |
|---|---|----------------------------------|---|------------------------------------|
| Municipal Representatives Elected Officials | Resort Municipality of Whistler (RMOW) | 1 | Revelstoke City Council | 1 |
| NGO's | Tourism Whistler | 2 | Tourism Revelstoke | 1 |
| Elected Officials | Resort Municipality of Whistler (RMOW) | 1 | Revelstoke and Mt. Mackenzie Ski and Snowboard Resort | 1 |
| Tourism Operator | Ziptrek Ecotour And Alpine Hiking | 1 | Brand Ambassador/Avid Skier | 1 |
| Ski/Hotel Resort Operator | Whistler Blackcomb association (WB) | 1 | N/A | N/A |
| Total: 10 | 6 | | 4 | |

Out of 20 selected participants only 10 chose to contribute to this study. Each interview lasted between 30-60 minutes.

3.2.4 Secondary data

In this study, secondary data was collected and analyzed from various sources, including government agencies and ministries, both federal or provincial and other NGOs. “Secondary data analysis involves a researcher using the information that someone else has gathered for his or her purposes. Researchers leverage secondary data analysis to answer a new research question or examine an alternative perspective on the original question of a previous study (Foley, 2019).

This method was useful as the topic of the study was too broad and needed lots of research and data from both environmental and tourism/commerce perspectives. There were many benefits for using this method in this study, including cost-effectiveness, thus enhancing the breadth and depth of data. On the other hand, there are some limitations and disadvantages of using this data in the study which were acknowledged. One potential challenge with secondary data is that the data may not have been gathered specifically for this study or may require interpretation for a different context than it was initially collected for at the start. Another issue that was mitigated in this research was by carefully monitoring the sources of the data and methodologies used as the data has been captured by other researchers (Foley, 2019).

3.3 Data Analysis

3.3.1 Active Interview Analysis

Information gathered from the interviews was assessed, in relation to themes presented in the regional climate change response model (adapted from Jopp et al., 2010), for differences, similarities, and patterns. For this research, a seven-step analytical procedure adapted from Marshall and Rossman (2016), Jopp (2010), Jones (2012) were leveraged as follows.

Step 1- Assembling and organizing the data

Each respondent's data were grouped based on four main interview themes: defining the tourism system (governance), risks and opportunities, response capability, and resort community preparation.

Step 2 – Immersion in the data

The researcher comprehended the information throughout the interview, during the transcription process, and when sorting and grouping the data.

Step 3 – Generating Categories and Themes

Identification of themes, recurring ideas, and patterns of belief leveraging the themes in Jopp's (2010) themes for climate change response model. After the information had been processed and transcribed, it was analyzed for repeating ideas, themes, and belief patterns.

Step 4 – Coding the data

Formally applying some coding scheme to identified categories and themes outlined in the previous step. The data was not subjected to any systematic coding scheme.

Step 5 – Offering interpretations through analytic memos

Assigning meaning to what was stated, deciphering the facts, providing explanations, and forming conclusions. Following the organization of each respondent's data into the assessment tool's themes, the data were examined for relevance to the study objective and sub-research questions and analyzed for meaning.

Step 6 – Searching for alternative understandings

Following the interpretation of the information, the researcher objectively challenges the prevailing apparent themes and patterns.

Step 7: Writing the report:

The researcher writes the report understanding that writing is part of the analytical process.

Report writing involved interpretation and meaning making.

3.3.2 Secondary Data Analysis

Secondary data was gathered to verify the correlation between information gathered from the interviews and the literature review, and the analytical model used. Various web pages, resort annual reports and plans, government reports, and academic and non-academic journals were reviewed and utilized as secondary data sources.

3.4 Study Limitations

There are constraints to any research endeavor. The potential constraints and limitations of this project are stated in order to make the research process straightforward and transparent. The researcher may have misinterpreted the qualitative information's genuine aim while evaluating it. Although every attempt was made to analyze data objectively, the researcher cannot guarantee that replies were not misinterpreted.

Despite the researcher's efforts to gather detailed information, only limited direct information on Whistler and Revelstoke, British Columbia, were publicly available. As a result, determining the relative scale and relevance of each risk factor for the communities proved quite challenging.

Based on this research, it is hard to make broad judgments about all-mountain resort towns' climate change adaptation methods. This study only addresses Whistler and Revelstoke, British Columbia, and cannot extrapolate to other communities.

Chapter 4: Results

The research background is described in this chapter, and the case study findings are presented in response to research objectives and questions. Expert interviews, as well as journal articles, official government papers, tourism plans, annual reports, and books, were used to compile the data.

1. Both resorts are taking the climate change response and planning measures. However, the breadth and depth of the implementation varied among the two resorts studied.
2. Implementing agile and effective climate action plans in a fast-changing environment requires a comprehensive grasp of the direction of change and its consequences for destination management.
3. Federal, provincial, and local government leadership and climate action programs are key for creating awareness for the direction of change and influencing.

4.1 Whistler's Governance Approach

Whistler Blackcomb Holding Inc. (WBHI), including its subsidiaries and Resort Municipality of Whistler (RMOW) are the primary stakeholders of North America's largest ski resort. The community's most valuable social and commercial asset is the winter mountain environment. Outdoor tourism-based communities, such as Whistler, have economies and cultures that are inextricably linked to stable natural conditions and are therefore more

susceptible to climate (RMOW, 2016). The stakeholders and programs influencing the RMOW and WBHI's climate change planning initiatives are further described in the next section.

4.1.2 Resort Municipality of Whistler (RMOW)

The notion of sustainability is not a new idea for Whistler and dates back to the 70s. however it was not until the mid to late 90s that it was solidified. Despite the inclusion of a variety of growth management measures in Whistler's Official Community Plans from 1976, 1982, and 1989, Whistler stakeholders' continued concerns about the city's rapid expansion prompted a community visioning process in 1997. The resulting "Whistler 2002" vision outlined the community's social, economic, and environmental objectives " "Building a "stronger resort community" (based on social sustainability ideals) and "working toward environmental sustainability" were two of the five objectives. The Whistler Environmental Strategy, which established a policy framework for moving toward environmental sustainability, was born out of this process (Szpala, 2008).

Stakeholder awareness and focus on sustainability grew significantly and the prospects of hosting the 2010 Winter Olympics further galvanized the stakeholders into adopting a new planning framework. The RMOW adopted the Whistler2020, which was the community's comprehensive, long-term sustainability vision. The Whistler 2020 was the foundation for the comprehensive sustainability plan (CSP), also known as an integrated community sustainability plan (ICSP) (Gill & Williams, 2012). The community vision, which began under the banner Whistler: It's Our Future, was formally accepted by the council in 2004 under the new title Whistler2020 – Moving Toward a Sustainable Future. In 2005, Council approved the first 16

plans for attaining the objective. The comprehensive sustainability plan (ICSP) is Whistler’s highest level policy document, and it guided the implementation of the “municipality official community plan” (OCD).

4.2 Highlights of Whistler Blackcomb’s Climate Change Strategy

Whistler Blackcomb has developed a seven-step strategic framework around three pillars: assessment, action, and advocacy. These three phases/steps are discussed in more detail in the following paragraphs.

| OVERVIEW OF WHISTLER BLACKCOMB'S SEVEN-STEP CLIMATE CHANGE STRATEGY | | |
|---|---|--|
| ASSESSMENT PHASE | 1 | What are the financial implications of climate change? (negative, neutral, positive) |
| | 2 | What are our emissions? |
| | 3 | Declared statement of commitment with goals and metrics of reduced emissions. |
| ACTION PHASE | 4 | Adaptation |
| | 5 | Mitigation |
| | 6 | Risk Diversification |
| ADVOCACY PHASE | 7 | Inspire others through your actions and education programs. |

SOURCE: INTRAWEST WHISTLER BLACKCOMB ND

Figure 1. *The need to accelerate Whistler Blackcomb’s climate action is clear, and the seven Big Moves and corresponding key initiatives are the priorities we need to invest our resources (Walker and Sydneysmith 2008).*

1. Assessment phase, at this step Whistler Blackcomb assessed the resort's expected climate change impacts as well as the financial implications. The resort used data from the Intergovernmental Panel on Climate Change (IPCC), which predicts a 120-meter elevation in the snowline for every degree Celsius as the temperature rises. The evaluation indicated that the ski resort could endure the financial repercussions of a 2 to 3.5°C increase in average global temperature this century compared to 1980-1999 using a scenario-based methodology. This is due in part to the resort's high level of adaptability. Whistler Blackcomb has a vertical climb of almost a mile, with the majority of the terrain located at higher elevations. Its physical geology resembles an ice cream cone, with a broad top and small bottom, allowing the resort to move ski sections upslope where snow is more plentiful, a comparative advantage that many lower-altitude ski resorts lack.
2. The second phase is called the action phase. This step includes mitigation, adaptation, diversification. The resort was able to build a partnership with external stakeholders such as BC Hydro, Innergex Renewable Energy Inc., and Ledcor Construction, to improve energy efficiency of the resort, and construct a micro-hydro plant (hydroelectric run-of-the river plant) that actually produces enough energy to power the resorts summer and winter operations for the year. Climate change adaptation strategies have already begun to be planned and implemented by Whistler Blackcomb. To preserve the size of its ski area, the firm has increased its snow-making capacity in recent years. The corporation is also investing in a summer grooming program, which includes removing boulders and smoothing out run surfaces using earth moving equipment, as well as establishing a thick grass root system, to improve ski run conditions in a warmer environment. These

practices have been shown to improve winter snow cover. Finally, plans have been created to boost upslope lift capacity and develop lift links at high altitudes. These improvements will allow Whistler Blackcomb to carry people further up the mountains to take advantage of higher elevation snowfall in the face of a changing climate in the coming years.

3. The third phase is called advocacy. In other words, the goal and aim of the resort is to inspire, educate, and advocate through their actions and storytelling rather than promoting.
4. Whistler set their benchmark to align with IPCC goals and this has helped them throughout their mitigation strategies. Furthermore, Whistler was bought by an American company called 'Vail' that manages 38 resorts, and their command and control is based in Colorado. Vail took the Whistler environment strategies and applied them to all of their 38 resorts. This was a successful and meaningful outcome in terms of, influencing and encouraging, about the importance of climate change and mitigation strategy.

4.5 Whistler Risk and Opportunities

This section discusses the ideas and information gathered from the interviews and literature reviews on the resort's existing and expected physical climate change consequences, as well as the risks, opportunities, and constraints. In other words, by understanding the Whistler Blackcomb climate change risks and opportunities, a comprehensive picture of the situation for the entire community is offered. The climate data reported in the next section, on the other hand, is sparse and should be regarded as a study restriction.

In summary, the data analysis shows 100% of respondents (six out of six) believed that climate change was happening and that their activities had been impacted in different ways. All respondents had experienced some unfavorable effects on their operations, but interestingly, some participants stated that in the short term, the effects of climate change were actually beneficial in their sector. According to participants' response, climate change has had some negative consequences on Whistler Mountain community such as avalanches, droughts, wildfires, extreme weather variable conditions patterns but the overall impacts have been constructive and have been controlled through planning, adaptation, or mitigation, diversification and alteration.

4.3.1 Risks

Decreases in Snowfall and Snowpack and increases in Winter Temperature

According to one of the participants "the annual average temperature in Whistler is projected to warm by about 3°C by mid-century. She mentioned that Whistler will face heavier rain, milder winter, and hotter and drier summer".

As previously mentioned in the literature review, the annual average temperature in the Whistler region is projected to warm by about 3°C by the 2050s compared to the recent past. This forecast is based on an average of climate model estimates, with expected warming ranging from 1.8 to 4.0 degrees Celsius. Annual precipitation is expected to rise by 7%, with a range of 0% to 10% (Pacific climate, 2009).

Milder winters offset potential advances in (December-January-February) snowpack on average throughout the area, despite greater winter precipitation. Elevation has a big impact on snowpack changes. Total anticipated drops in Whistler Village, for example, are roughly 50 to 100 cm (about 60 percent to 70 percent reductions relative to historical values). While the

combination of changes projected for Whistler are consistent with the rest of British Columbia in terms of heavy rain, and coastal areas in terms of drier and hotter summers, and milder winters with reduced snowpack mostly at the lower elevations.

“Whistler contributes 25% of the province’s tourism earnings, and about 75% of Whistler’s entire income is made between January and March, and has to do with winter sports activities,” an RMOW elected official noted. Despite the fact that the informant provided no scientific information regarding current and predicted snowfall, the RMOW voiced concern about ‘future’ snow quality and quantity. If future snow conditions are unfavorable, visitor numbers to WB and the surrounding area are projected to decrease.

The participants were mostly worried about the snow level and higher degree of precipitation in the lower elevation and valleys in the winter. They appeared to anticipate that, even if the summit’s snow conditions remained unchanged, the alteration efforts and adaptation measures would improve tourist numbers in the future. They also recognized other development opportunities and targeting new market segments such as conferences and exhibitions during the off-peak season to diversify the source of revenue. This market segment has been a significant contribution to the resort.

Increases in Summer Temperature

Increase in summer temperature is something that concerns almost all of the Whistler and Blackcomb administration and NGOs. Based on the information gathered for this research they all believe greenhouse gas emissions and carbon footprint, which are all caused by humans, are the main factors in seeing massive wildfires in recent years. Therefore, WB is already taking proactive actions towards wildfire mitigation by incorporating Fire Smart principles to all the

mountain community. As one of the participants articulated: “So in terms of wildfires, we know there will be more, so we have a lot of plans such as Fire Smart projects. We help people to fire smart their properties. We have fuel thinning projects where we find and clear out the forest to remove some of the dry material that would be ideal fuel for wildfires to prevent them coming too close to the village”. The participant also provided some of the future plans they are taking to address the impact of climate change such as: “Alternative economic opportunities, fire smarting is kept and when we look at future buildings, we know it's going to be hotter in the summer, so we know there's more demand for cooling and all of those aspect. We are aware and planning to implement them in all departments going forward”. The participant also mentioned that most of these projects are discussed between all departments but still they are not seeing much improvement or actions due to separation and lack of collaboration between sectors and governments.

4.3.2 Climate Change Opportunities

Increase in Summer Activities or Diversification

While increasing temperatures pose a significant risk to WB, they also present opportunities such as expanding their outdoor activities. In the last decade, WB began diversifying their business operations in order to be able to function and be successful in the near future without relying on excellent snow. Mountain biking, sightseeing, wildlife viewing, hiking, golfing, zip lining, ATV tours, rafting, horseback riding, cultural tourism experiences, and other festivals and events are all part of a larger experience being carefully implemented in the area's mountain environments by WB and other private operators. This diverse choice of activities may attract tourists all year, not only during the ski season. One of the participants put it this way:

"Summer tourism has grown at a faster rate than winter tourism in the recent decade, thanks to the Olympics." However, because this information was not based on statistics, there may be certain limitations that need to be investigated further. Other limitations that should be further considered is the licensing and permitting from the provincial government for different land uses which can be a determining factor for the climate change mitigation opportunities that can be pursued.

4.3.3 Barriers and Constraints

The informants most commonly identified the political, economic, as well as non-linear environmental sustainability considerations as key barriers the resort is facing. However, external research "on the nature of barriers to climate change adaptation" confirms that the topic of barriers can be complex and contextual (Biesbroek et al., 2013).

Lack of Collaboration

Collaboration is one of these more intangible areas of action, which is critical given jurisdictional constraints and how partnerships may improve efficacy (Boswell et al., 2019; Dale et al., 2018). According to Boswell et al (2019), "most climate actions are sufficiently complex and cross-cutting that they are best implemented by developing robust, committed community partnerships among government agencies, businesses, and community groups" (p. 239).

The results of this research reveal disconnection and lack of close collaboration between the sport community /businesses, NGO organization, and the municipal government and the WB resort. Furthermore, many hotels are part of international chains, governed by their respective corporate policy direction and are not based on locally developed policy. Interviews from

different sectors highlighted multiple policy directions and misalignments. Therefore, the resort and government may benefit from a more collaborative approach in order to meet their climate change targets.

One example: according to interviews in WB, one from local government and other from Tourism Whistler, stated government and marketing for tourism and hotel goals do not align with each other and each work in a direction that mostly benefits their respective sector causing “Conflict of interest” and will draw them back from working toward the whistler2020 goal (net-zero emission).

Lack of Authority and Power

Another important aspect that all informants highlighted was the complex governance structure and the distribution of authority between local, provincial and federal governments, which was brought up a few times as key factor impacting the resorts’ ability to deal with climate change. Resort Municipalities such as Whistler in British Columbia have an elected mayor and council, as well as a local government bureaucracy in charge of infrastructure, law enforcement, and safety, as well as enacting and enforcing land use and development regulations (Whistler, 2011). Furthermore, as an incorporated municipality, its politics and practice of planning mirror those of other places in fundamental ways. However, the politics and power dynamic of the resort municipalities are unique and often shaped by the economy of the resorts given being primarily focused on a single industry. Therefore, the federal/provincial government may further empower or the local governments and provide oversight for the resorts so they can deliver what is asked required and asked of them.

4.4 Revelstoke Governance Structure

The BC government has provided funding to numerous towns in recent years through the gas tax to construct Integrated Community Sustainability Plans (ICSPs). ICSPs inspire communities to look at their future through different lenses and focus on strategies and tools to become more sustainable. According to Revelstoke (2012), ICSPs assist communities to envision, plan, and implement activities that will ensure their long-term well-being. It also provides a framework/ guideline for communities to prepare for their current needs while simultaneously guaranteeing that future generations' needs are satisfied. Other levies such as the 8% municipal and regional district tax charged by hotels and other roofed accommodations were used to fund local destination marketing organizations.

Revelstoke has already taken significant steps in the direction of sustainability, especially for a small community. The commitment of the community to combine environmental, social, and economic principles to assure long-term sustainability is reflected in the city's 1994 Community Vision, Community Development Action Plans (CDAPs) in 2001 and 2006, and Official Community Plan (OCP). Revelstoke adopted a vision "to be a leader in building a sustainable community by balancing environmental, social, and economic principles within a local, regional, and global context," Since it was established through a broad-based community process in 1994, Revelstoke's Community Vision Statement has steered the community toward sustainability (Revelstoke, 2012). The Vision includes the following main themes:

- economic resilience.
- environmental protection.
- inclusivity and support of all residents and their diversity, and
- protection and conservation of our mountain community heritage.

The construction of Revelstoke's ICSP is being guided by a community-based steering group designated by the city. The project team includes specialists with experience in social, economic, environmental, and community planning and action from both inside and beyond the community, reflecting the ICSP's breadth.

The plug BC and clean BC grant in the province to electrify the infrastructure and commercial fleets, are influential and beneficial strategies at the provincial level. Carbon offset programs used by companies, individuals, and businesses to neutralize their carbon emission not a sentence, revise. The carbon offset programs allow individuals and companies to invest in carbon offset projects, locally or internationally, to balance their carbon footprints.

Another helpful government strategy is Bill C-12 which will hold the current government and future governments accountable to targets so that they are actively fighting against climate change and working towards zero emission

4.5 Revelstoke Risk, Opportunities, and Barriers

When respondents were asked whether they believed that climate change was occurring or not, 100% (four out of four) of respondents said it was happening and that their operation/sector somehow had been impacted. All participants in this study had experienced some negative impacts on their sector. However, surprisingly, some mentioned that they have witnessed and experienced some positive benefits resulting from the adaptation and mitigation measures resulting from climate change. The common theme for this centered around an increased number of visitors from diversifying and expansion of activities offered.

Therefore, the purpose of this portion of the research is to illustrate and discuss the corresponding risks and opportunities as well as barriers that climate change poses to the Revelstoke Mountain community. The following subsections will present the current and

predicted risks, opportunities, and barriers gathered from this research's interviews and literature review.

4.5.1 Risks

The following subsections identify the climate change risks to the Revelstoke in the short term and long term. The information provided in the following sections are only based on the data and information gathered for the purpose of this study and could be challenged given it is based on interview data from a limited sample.

Decline in Snowfall and Snowpack and increases in Winter Temperature

Increases in winter temperatures are expected to have a severe influence on Revelstoke's snow-based winter tourism, such as downhill and Nordic skiing. Less snow, especially at lower elevations, may increase the requirement for artificial snowmaking at RMR, putting further strain on the local water supply. One of the selected respondents highlighted the following risks, “we struggle in the beginning and end of the year with the lack of snow and cannot get enough snowpack in the lower elevation, we get rain in the top which puts the mountain community in danger for possible avalanche”. This statement illustrates that the resort and different sectors are already aware of the negative consequences of climate change and that they are taking actions to minimize these negative impacts on their businesses and organizations.

The respondents also mentioned that due to the lack of snow in lower elevation as well as the complication of using snowmaking systems, they are moving most of their base operations to the top of the mountain lodge. The participants stated that their snowmaking system only runs in the lower elevation about 300 meters and although there is a gap, they get enough snowpack at the higher elevation. Therefore, they are planning to expand their snowmaking system adaptation

technique to cover 700 meters in between. The risk of relying too much on snowmaking as a permanent adaptation tool in the long term is too high for Revelstoke, as the snowmaking system is designed to function only in below zero temperatures which might be challenging in the future due to climate change.

Increase in Summer Temperature

According to one of the participants the increases in summer temperatures, along with decreases in summer precipitation, are expected to dry up the forest and increase the danger of interface wildfires in Revelstoke. Wildfires can have a wide range of consequences, including infrastructure damage, loss of life, forestry industry impacts, and road and transit closures.

The Community Wildland Fire Prevention Committee (the Committee) for the city has produced upgraded wildfire risk mapping recently and revised wildfire protection recommendations.

Wildfires, on the other hand, were identified as a priority danger, with wildfire risk reduction and climate change adaptation planning and action being closely related. The top risk reduction suggestions are to:

1. preserve the city's water supply and water system.
2. build strategic fuel breaks.
3. limit hazards on RMR properties.

4.5.2 Climate Change Opportunities

Respondents all agreed that one positive impact of climate change they are noticing is expansion of the activities offered by Mt. Revelstoke and Mt. Mackenzie and the increase in the visitors. They believed that the resort and mountain community of Revelstoke is implementing and practicing innovation and creativity rather than only relying on ski tourism. Respondents

identified the following activities as a life-savior for the tourism sectors. These activities include mountain biking, hiking, climbing, disc and golf course and many more summer activities.

Therefore, the operators and sectors have access to a broad range of products and activities in response to changing weather conditions. Most participants identified and made examples of the success stories in satisfying and attracting more visitors throughout the year round even when the weather was not cooperative.

4.5.3 Barriers and Constraints

Lack of Leadership and Guidance

The resorts in the province are generally governed by the Land Act and specifically the land use operational policy for the all-seasons resorts. Whistler on the other hand is the lone resort municipality in the province created by the Resort municipality of Whistler act. The lack of guidance, leadership, as well as the existence of restrictions and guidelines on outdoor tourism were all seen as barriers to addressing climate change by all of the interviewees. Albeit, not impacting both resorts to the same extent given Whistler's resort municipality status.

Backcountry.

Access to limited funds and grants

Almost all of the individuals who were interviewed identified funding as a major issue for combating climate change and its consequences on their businesses and sectors. The Revelstoke Mountain heavily relies on Heli skiing, and there many people who would travel across the country to engage in the activity. The interviewees are all aware of the risks and effects of Heli skiing (aviation tourism) on the environment and ecosystem and are hoping to be able to offset with electricity and energy efficient transportation and Heli skiing in the near future.

Chapter 5: Discussion

Like other mountain-based resort communities in the province, Whistler and Revelstoke economies are heavily dependent on winter sports and ski attractions during the winter season. Recent research conducted by the University of British Columbia's climate scientists suggests that both Whistler and Revelstoke will follow the coastal model and would significantly impact the symptoms of climate change (Pidwirny, 2020). A projected decline in snowfall by the middle of the century can negatively impact the appeal of these resorts to visitors and introduce high risks for these communities (Resort Municipality of Whistler, 2016). There is a strong correlation between climate and the economic performance of the resorts. The resorts rely heavily on natural and technical snow (snowmaking) reliability.

This research suggests that the development and implementation of the community climate action plans were historically independent of provincial and national endeavors. However, recent trends demonstrated a transition to a more increasingly interactive approach that transcends traditional governance boundaries. Therefore, the prospects of the mountain-based climate action plans rely on the level of collaboration and alignment of the stakeholders in the new governance boundaries and framing of the problem through a more holistic lens.

Whistler and Revelstoke climate change response plans are resulting from the resorts robust community-based approach to sustainability planning consistent with established literature related to sustainable governance and climate change such as Jopp et al. 2010 and Gill & Williams, 2011.

This research identified political barriers, complexities of collaboration with various stakeholders in a multilevel governance structure, and slow transition to an interactive

governance model as key barriers impeding change and preventing the communities from taking drastic measures required to address climate change risks. However, both resorts are now in a much stronger position thanks to recent internally and externally sponsored research providing climate risk analysis, and climate modelling for both resorts. This information has been important for raising awareness and the urgency for mitigation and adaptation measures among key stakeholders and warranted the need for a faster transition to an interactive governance model.

The climate change risks and potential impacts on the economic viability of the resorts have motivated both resorts to adopt new governance forms and transition to multilevel governance. Expand, in what ways. Both resorts developed their community sustainability plans and their respective climate action strategies. However, the expert interviews showed that the climate mitigation and adaptation initiatives might not be adequate under specific scenarios. Scenario analysis in identifying climate-related risks and opportunities specific to the resorts may enable the resorts to strengthen further their plan and initiatives following in response to different climate change scenarios.

Although this research identified increased awareness of key resort stakeholders regarding potential climate challenges and impacts of global warming on the resorts, both resorts may benefit from a clearer and more in-depth climate risk analysis and climate modelling. Raising awareness and, as a result, the general public's knowledge of the impacts of climate change, can also aid changes in behavioural and public support for response initiatives. Furthermore, the efficacy of Jopp et al.'s 2010 model hinges on effective data. Local governments and ski areas cannot precisely construct a climate change response strategy in the

absence of climate data and without recognition of direct impacts of climate change on their communities. Therefore, the model could be expanded in future studies to address the scientific uncertainties.

5.1 Study Limitations

The researcher faced three primary study limitations during this research. First, this research was conducted during the COVID-19 era, which limited the researcher's access to the local communities for qualitative data collection.

Second, the lack of data and climate modelling specific to the two resorts studied limited this research's quantitative assessment and climate risk analysis. The researcher attempted to address this by leveraging information obtained from the expert interviews and comparing climate data from comparable resorts.

Third, the research leveraged semi-structured qualitative interviews to obtain insights and information. Although every attempt was made to keep the process identical and objective, the researcher cannot guarantee that the information obtained was not subject to any biases.

Chapter 6: Conclusion

The rise in popularity of resort destinations in recent decades has sparked interest in the governance structures that enable such growth, as well as the management practices that ensure their long-term viability. As their vulnerability to global forces become more apparent, there are demands to reconsider the appropriateness of investor-driven pro-growth resort development plans. Destination stakeholders are increasingly reconsidering how they "conduct business," including who has decision-making authority, how choices should be taken, and to whom

decision-makers should be responsible. Climate change planning has become a key component of business planning for the ski resorts industry (Scott et al., 2020). The competitiveness and long-term viability for winter destinations depend on good governance, based on sound science and policy, which are implemented through effective and considered practices (Guia, Prats, & Comas, 2006). "Achieving competitive advantage in times of fast change needs tourism stakeholders to have a comprehensive grasp of the direction of change and its consequences for destination management," writes Dwyer, Edwards, Mistilis, Roman, and Scott (2009, p. 63).

My data reveals that resort communities are very aware of climate change impacts on their sectors and the need to adapt and mitigate their risks. Far greater collaboration is needed, however, to scale up their plans and to increase the take-up of innovations to address their risks due to so many exogenous variables out of their control. And of course, sustainability of destination resorts must respond to the necessity to mitigate environmental travel costs.

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