Climate-induced environmental change and the future of tourism at the Athabasca Glacier in Jasper National Park

by
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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Nature-based tourism is an important element of the tourism industry in North America and a sizeable share occurs in national parks located in the mountainous regions of western Canada and the United States. However, the major tourism resources located in parks and protected areas are projected to undergo largescale changes as a result of climate change. The implications for visitation, tourist satisfaction and park management remain largely unexplored and there is little understanding of how adaptations pursued by park managers and stakeholders may change the way potential visitors perceive destinations. The aim of this research is to determine how much change the Athabasca Glacier can sustain from its current state from the visitor perspective within each of the three components that make up the concept of carrying capacity: environmental resources, type and quality of the experience, and extent and direction of management action. Using the limits of acceptable change framework and scenario planning, visualizations of four tourism development scenarios for 2050 were developed and presented to tourists at the Athabasca Glacier through a tablet-based survey. The survey examined visitor perceptions of carrying capacity issues and satisfaction with current and future experiences. The subsequent findings indicate that if the type of landscape change anticipated were to occur satisfaction would decrease. Satisfaction with the tourism development scenarios decreased as the number of people and facilities and infrastructure increased and commitment to ecological integrity decreased. The results from this study can be used to better inform policy and management decisions at the park level and help identify what needs to be done to protect Canada's significant nature-based tourism industry in western Canada.

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Dedication

This thesis is dedicated to my grandpa.

Thank you for always believing in me and encouraging me to chase my dreams.

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Chapter 1: Introduction

1.1 Research Context

An important element of the tourism industry in North America is nature-based tourism, which mostly occurs in parks and protected areas (Scott et al., 2007). Canada alone has 44 national parks, 167 national historic sites and four national marine conservation areas that attract over 14 million visitors per year (Parks Canada, 2016; Parks Canada, 2015b). Approximately 59% of all visits to national parks occur in one of the seven mountain national parks (Jasper, Banff, Glacier, Kootenay, Mount Revelstoke, Yoho and Waterton Lakes), which represent the Columbia and Rocky Mountains natural regions (Parks Canada, 2016). National parks protect approximately 306,700 km^2 of Canada's land (Parks Canada, 2015b) and contribute over three billion dollars to Canada's gross domestic product (Canadian Parks Council, 2011).

The initial idea of parks and protected areas in Canada was heavily influenced by economic development and for that reason parks were considered primarily as places of recreation and tourism (Needham et al., 2016a). However, an amendment to the National Parks Act was made in 1988 and the federal government began prioritizing the preservation of nature and ecological integrity alongside visitor experience. Ecosystems are considered to have integrity when they have their native components intact, including: abiotic components, biodiversity, and ecosystem processes (Parks Canada, 2016). Parks and protected area managers make decisions that influence the future integrity of parks, yet these decisions are usually based on current circumstances without giving full attention to possible scenarios and forces that will likely influence the future (Jager & Sanche, 2010; McNeely, 2005).

Many of the mountain parks, such as Jasper, have had a long history of conservation and tourism (Parks Canada, 2010) and the tension between tourism development and protection still

exists (Parks Canada, 2015a). Scholars such as, Eagles and McCool (2002); Manning (2011); and Needham et al. (2016a) have acknowledged that the demand for nature experiences and recreational activities have environmental, social and managerial implications. Needham et al. (2016a) and Wright (2016) also suggest that climate change could have serious consequences on the major tourism resources in parks and protected areas. Planning and management in parks can be guided by frameworks, such as limits to acceptable change (LAC), which offer applied and theoretical tools for understanding acceptable and unacceptable conditions, and identifying approaches for monitoring and managing conditions that help to protect park resources, provide satisfactory visitor experiences, and create a constituency of park supporters (Rollins et al., 2016).

Climate-induced environmental change is projected to have a profound impact on several environmental resources that are important features of these natural areas, such as alpine glaciers, beaches and coral reefs (Allison et al., 2009; McMullen & Jabbour, 2009; Parry et al., 2007; Scott et al., 2012a; UNWTO-UNEP-WMO, 2008). These natural attributes, among others, influence visitor motivations and perceived attractiveness of a destination and several authors have acknowledged that destinations affected by climate change are more likely to be impacted by changing tourist perception and visitor behavior (Csete & Szecsi, 2015; Gossling et al., 2012; Jopp et al., 2015). However, the implications for visitation, tourist satisfaction and park management remain largely unexplored and tourist perceptions and responses to environmental change are not well understood (Gossling et al., 2012; Gossling & Hall, 2006a; Jopp et al., 2015; Scott, 2008; Scott et al., 2012a). It is also unclear if adaptations may change the way potential visitors perceive destinations and whether these changes in perceptions are likely to result in significant changes in visitor behavior. Understanding perceptions of climate change and how

the loss of specific features, such as glaciers, will affect visitor behavior and perceptions can help inform resource management, policy development and environmental decision-making (Brownlee et al., 2013; Doherty & Clayton, 2011; Lemieux, 2016). For a tourist destination to remain sustainable and competitive in the long term, policy-makers and destination managers need to understand the potential risks and opportunities presented by climate change and so they can plan to adapt accordingly (Jopp et al., 2015).

1.2 Research Goals and Objectives

Understanding visitor perceptions and satisfaction is necessary for informing park planning and management (Rollins et al., 2016). This study will examine visitor perceptions and satisfaction of projected environmental change at the Athabasca Glacier. The goal of this research is to determine how much change from the current conditions the Athabasca Glacier can sustain within each of the three components that make up the concept of carrying capacity: environmental resources, the type and quality of the recreation experience, and the extent and direction of management action. Primary data was collected using visitor surveys that were distributed at the toe of the glacier trail at the Athabasca Glacier. The survey presented visitors with visualizations of projected environmental change and four potential tourism development scenarios for 2050. The findings from this study will provide park management with an in-depth understanding of how climate impacts and adaptation could influence tourism by shaping visitor experience. To realize this goal, three objectives were formulated to guide this research:

1. Understand the factors that influence visitor satisfaction with the current visitor experience and future tourism development scenarios;
2. Identify the relationship between overall satisfaction with the current visitor experience and visitor satisfaction with future tourism development scenarios;

3. Use environmental visualizations and visitor surveys at the Athabasca Glacier to better understand how visitors might respond to environmental change.

1.3 Structure of Thesis

This thesis has been organized into six chapters: introduction; literature review; methods; results; discussion; and conclusion. Chapter one has provided the research context, goals and objectives. Chapter two will provide a literature review of topics such as, parks and protected areas, climate change, carrying capacity, limits of acceptable change, consumer behavior, adaptation, scenario planning, and environmental and landscape visualizations. Chapter three will describe the methodology used in this research and provide an overview of the case study, development of visualizations, survey design, data collection, analysis and limitations. Chapter four will present the results, which will be discussed in chapter five. The thesis will conclude in chapter six with a discussion of future research opportunities, recommendations for Parks Canada and final thoughts.

Chapter 2: Literature Review

2.1 Introduction

This chapter will provide an overview of nature-based tourism, the impacts of climate change on tourism, glacier tourism, carrying capacity, limits of acceptable change, consumer behavior, adaptation, scenario planning, and environmental and landscape visualizations.

2.2 Nature-Based Tourism

Nature-based tourism is a growing global industry that relies on elements of the natural environment, especially in parks and protected areas (Eagles, 2002). It has also been described as a form of tourism that takes place in a natural setting, tourism that focuses on specific attributes of the natural environment, and tourism that is developed to conserve or protect natural areas (Hall & Boyd, 2005). It depends on a high diversity of tourism resources, such as landscapes, flagship species, ecosystems, and water resources (UNWTO-UNEP-WMO, 2008). Most tourism in protected areas is nature-based as tourism takes place in natural settings where the settings are an integral part of the attraction (Rollins et al., 2009).

The resources that nature-based tourism depend on will be affected by climate change in various ways (UNWTO-UNEP-WMO, 2008). Although these resources can be highly vulnerable to climate change impacts, there are good adaptation options in ecotourism as there are a wide range of activities that can be developed and conducted in natural areas (UNWTO-UNEP-WMO, 2008). Ecotourism has been referred to as a more stringent form of nature-based tourism (Rollins et al., 2009). The term describes a specific travel market and characterizes those who select an experience or destination that is pristine and nature-oriented (Eagles, 1992). Ecotourism involves activities that seek to minimize negative impacts on the environment but also attempts to benefit the natural environment (Rollins et al., 2009). Weaver & Lawton (2007) argue that definitions of

ecotourism share three core criteria: (1) attractions should be nature-based; (2) visitor interactions with those attractions should be focused on learning or education, and (3) experience and product management should follow principles and practices associated with ecological, socio-cultural and economic sustainability. This form of tourism has shown the potential to generate revenue, employment and other economic and social benefits (Eagles, 2002).

2.2.1 Parks and Protected Areas

Parks and protected areas are one of societies' most valued cultural creations (McCool & Eagles, 2015). According to the IUCN (2014), a protected area is "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values". There are over 200,000 protected areas worldwide that protect approximately 14.6% of the world's land and 2.8% of the world's oceans (IUCN, 2014). Protected areas have a long history of use for recreation and tourism as they provide people and communities worldwide with social, environmental and economic benefits (IUCN, 2014). However, the popularity and expanding use of parks and protected areas has resulted in concern about appropriate use levels and the impacts of tourism on the environment (Eagles & McCool, 2002; Manning, 2011; Needham et al., 2016b). Although visitor use and infrastructure development remain threats to ecological integrity, Wright (2016) states that the greatest threat to conservation within parks and protected areas has become climate change. It represents a major threat to the integrity of global protected areas and resulting changes are starting to affect nature-based tourism assets and the quality of visitor experiences (Brownlee et al., 2014; Sharp et al., 2014).

Park managers increasingly find themselves in a challenging position to protect representative natural areas, while offering visitor opportunities (Needham et al., 2016b). The

major challenge is how to manage visitor use in a way that protects park resources, provides satisfactory visitor experiences and creates a constituency of park supporters (Needham et al., 2016b). Park managers often receive requests to provide more visitor facilities, activities and services, which is not always possible due to limited public funding and the fact that it would result in a loss of natural character and conversion into developed landscapes (Needham et al., 2016b; Rollins et al., 2016). Some park agencies and managers have also struggled with declining visitation and associated revenue levels (Needham et al., 2016a) because of societal shifts, such as gaining population, urbanization, time pressures and travelers preferences for diverse experiences (Jager & Sanche, 2010). This has forced park managers to become more innovate in finding resources to sustain adequate levels of park management, which has resulted in commercial developments that generate more diverse revenue streams (Rollins et al., 2016). Consequently, visitor management has become increasingly complex as it needs to address social, facility and ecological impacts both within and adjacent to parks and protected areas (Needham et al., 2016b).

2.2.2 National Parks in Canada

Parks Canada is a government funded agency that operates under the Minister of the Environment to manage national parks, national historic sites and national marine conservation areas (Parks Canada, 2015b). The mandate set out by Parks Canada is as follows:

> *"On behalf of the people of Canada, we protect and present nationally significant examples of Canada's natural and cultural heritage, and foster public understanding, appreciation and enjoyment in ways that ensure the ecological and commemorative integrity of these places for present and future generations"* (Parks Canada, 2015b).

The Parliament of Canada passed the first National Parks Act in 1930 declaring that parks are "dedicated to the people of Canada for their benefit, education and enjoyment and such parks shall be maintained and made use of so as to leave them unimpaired for the benefit of future generations" (Needham et al., 2016a). This is often referred to as the dual mandate as there were competing purposes for recreation and conservation (Wright, 2016). In 1988, an amendment to the National Parks Act was made that emphasized that the "maintenance of ecological integrity through the protection of natural resources shall be the first priority when considering park zoning and visitor use in a management plan" (Canada, 1988). This reinforced a shift in the primary purpose of parks from recreation to the protection of natural resources. To address the amendment, Parks Canada began defining and implementing programs that embodied and emphasized the protection of the park resources over the traditional emphasis on development, tourism and recreation (Needham et al., 2016a). For example, each national park was required to prepare a management plan that reflected the policies and legislations of the federal government with an emphasis on the three elements of the mandate; resource protection, visitor experience, and public appreciating and understanding (Parks Canada, 2010).

The management plan serves as a framework for planning and decision making at the park level (Parks Canada, 2010). Revisions to the management plan are made every five years through a document called the state of the park report, which summarizes the park's current conditions based on key indicators and assesses performance in advancing the agency's mandate (Parks Canada, 2010). In 1991, Parks Canada conducted the first state of the park reports, which acknowledged that none of the parks were immune to internal or external threats, and cited water pollution, poaching and logging on lands near parks as some of the major threats (Needham et al., 2016a). Nearly a decade later, Parks Canada also confirmed that more than one-third of its

parks reported concerns about the increasing impacts of human activities on park ecosystems (Needham et al., 2016a).

Many park enthusiasts and supporters advocate for national parks to be places of preservation and protection with limited use and visitation (Parks Canada, 2015a). However, visitation to national parks is essential for developing a sense of connection. 90% of Canadians who visited a national park expressed having a sense of connection, while only 20% of Canadians who have not visited a national park felt the same way (Parks Canada, 2015a). Maintaining the dual mandate set out by Parks Canada has become increasingly difficult due to declining visitation and associated revenue, which has led to more attention being placed on diversifying attractions and overnight accommodations (Needham et al., 2016a). Parks managers continue find themselves in the center of the relationship between recreation and conservation (Arocena et al., 2004).

2.3 Climate Change and Tourism

Compelling evidence indicates that the global climate has changed compared to the pre-industrial era and it is anticipated that it will continue to change over the 21st century and beyond (IPCC, 2013). The globally averaged combined land and ocean surface temperature data show a warming of 0.85°C over the period 1880-2012 and the total increase between the average of 1850-1900 period and the 2003-2012 period is 0.78°C (IPCC, 2013). Warming of the climate system is unequivocal as the atmosphere and ocean have warmed, the amount of snow and ice has diminished, sea level has risen and the concentrations of greenhouse gases has increased (IPCC, 2013).

Science now indicates with 95% certainty that human activity is the dominant cause of observed warming since the mid-20th century (IPCC, 2013). The tourism industry is a contributor

to climate change because of its use of fossil fuels and emissions of greenhouse gases (UNWTO-UNEP-WMO, 2008). According to the UNWTO-UNEP-WMO (2008), it is estimated that the tourism industry produces approximately 5% of total global carbon dioxide (CO_2) emissions with transportation and aviation contributing 75% and 40% of the CO_2 emissions generated by tourism.

Climate change has already begun transforming and will further transform, terrestrial and marine environments on every continent (Scott et al., 2012b). It has the capacity to affect destination competiveness with impacts on tourist flows and expenditures (Dwyer et al., 2010). The impacts of climate change are anticipated to be widespread, which is concerning for the tourism sector as it is often based on natural resources (Csete & Szecsi, 2015; Scott et al., 2012b). For example, in Canada a considerable proportion of natural resources are conserved in protected areas and managers could experience significant changes in consumer behavior as a result of climate induced biophysical changes to resources and tourism assets (Lemieux, 2016).

Understanding visitor perceptions of climate change and how the loss of specific features, such as glaciers, will affect them can help inform resource management, policy development and environmental decision-making (Brownlee et al., 2013; Doherty & Clayton, 2011; Lemieux, 2016; Scott et al., 2007). Brownlee et al. (2013) acknowledged that there has been a considerable amount of research investigating the perceptions of climate change and related factors, but few have investigated how visitor interactions with climate-impacted parks and protected areas influence perceptions and support for environmental management. Conversely, in heavily developed metropolitan areas, the impacts of climate change remain largely unnoticed (Brownlee et al., 2013). Therefore, parks and protected areas provide unique opportunities to experience, notice and respond to climate change impacts, which has the capacity to influence

individual perceptions (Brownlee et al., 2013). The impacts of climate change have become an increasingly pressing issue for parks and protected areas because of the role tourists play in selecting a destination (Scott et al., 2012a).

2.3.1 Climate Change Impacts

Scott et al. (2012b) identified that climate change will impact the tourism system in four distinct ways: direct impacts from changing climate regimes, indirect climate-induced environmental change, indirect impacts associated with societal change, and impacts induced by climate change mitigation and adaptation in other sectors. These impacts will affect all major components of the tourism system, such as tourists, source markets, transportation systems and destinations (Scott et al., 2012b). The collective impact of climate change on tourism will vary among subsectors and geographic regions and consequently, there will be winners and losers at all levels (Scott et al., 2012b).

It is recognized that climate is a principle resource for tourism as it provides the foundation, suitability and timeframe for outdoor recreation and ultimately influences the level of visitor satisfaction (Scott & Lemieux, 2010). Changes in climate will directly affect tourism in four ways: (1) altering the geographical and temporal distribution of climate resources as a push-pull factor for tourism; (2) changing the length and quality of climate-dependent tourism seasons; (3) influencing operating costs; and (4) creating damage from extreme events (Scott et al., 2012b). Additionally, climate change will indirectly influence environment conditions that are often critical resources for tourism as the natural environment is an essential component of the nature-based tourism industry (Scott et al., 2012b). For example, the impact on natural assets will include changes and degradation of landscape aesthetics, sea level rise and coastal beach assets and infrastructure, water availability, terrestrial and marine biodiversity loss, altered

wildlife productivity and distribution, more accessible Arctic, altered agricultural production and increasing incidence of vector-borne disease (Scott et al., 2012b).

Climate change could indirectly pose a risk to future economic growth and stability as any reduction in GDP in tourism-generating areas would reduce the discretionary income available to tourism consumers and negatively affect anticipated future growth in tourism worldwide (Scott et al., 2012b). Mitigation policies are likely to have important impacts on the transport sector and consequently on tourist flows, as changes in cost structures could cause tourists to reconsider transportation modes and the distance they travel for tourism (Scott et al., 2012b).

As a result, the implications of climate change will affect destination attractiveness, tourism demand and destination choice. As climate change causes lasting alternations to the natural environment of destinations, tourism products and environmental services can be diminished, with implications for tourism activities, destination image, and capacity of tourism firms to do business suitably (Scott et al., 2012b).

2.3.2 Glacier Tourism and Climate Change

Many glaciers worldwide have become popular tourist attractions, such as the Athabasca Glacier in Canada and the Fox and Franz Josef Glaciers in New Zealand. Glacier tourism refers to tourism activities in glaciated areas, such as sightseeing, scientific research, exploration and education (Liu et al., 2006). It differs from conventional tourism because of four distinct characteristics: (1) resources are scarce and fragile; (2) activity is localized; (3) tourism connotation is scientific; and (4) function and value of glacier tourism is comprehensive (Welling et al., 2015). Typical activities in glaciated areas currently include: glacier hiking, ice climbing, skiing, snowmobiling, commercial activities and glacier lake kayaking (Welling et al.,

2015). Glacier tourism operates in highly fragile and sometimes inaccessible environments that require specific infrastructure, which can have negative impacts on the environmental, as well as the aesthetic value of the landscape (Welling et al., 2015).

There is growing concern about glacier environmental protection and the implications of climate change on glaciers. Since the end of the 1970s, rates of retreat, thinning and volume loss of glaciers around the world has increased and will continue to increase, further altering the physical landscape of mountain destinations (Tennant & Menounos, 2013). One of the most prominent examples is Glacier National Park in Montana, which has lost 115 of its 150 glaciers over the past century. Scientists estimate that the remaining 35 glaciers will disappear over the next 30 years (Hall & Farge, 2003). The disappearance of one of the park's most charismatic features presents great irony and aesthetic loss, as the park was established to protect the natural resources and landscape that has now changed (Hall & Farge, 2003).

Climate-induced environmental change has also been documented at several other glaciers worldwide. In North America, 98% of Alaska's glaciers are retreating or thinning (Molnia, 2007) and in the last 125 years the Athabasca Glacier has lost half its volume and retreating more than 1.5 km (Parks Canada, 2014). The Forni Glacier in Italy has lost 36.2% of its volume and retreated by approximately two kilometres from the end of the little ice age (~1860) to 2007 (Garavaglia et al., 2012). In Norway, 27 out of 31 glaciers were in the process of retreat in 2010 (Furunes & Mykletun, 2012) and the glaciated area at Yulong Snow Mountain in China has decreased up to 26.78% since 1957 (Wang et al., 2010). In New Zealand, between 2008 and 2015, the Fox glacier lost over 700 m in length (Purdie et al., 2015) and similar length reductions have occurred at the neighboring Franz Josef Glacier (Purdie et al., 2014). Recent climate-glacier modeling indicates that by 2100 the Franz Josef Glacier will recede from a length

of 11 km to 6.4 km and shed 62% of its volume (Anderson et al., 2008). The shrinkage of glaciers worldwide provides compelling evidence that global environmental change is occurring (Hall & Farge, 2003).

2.4 Carrying Capacity

The concept of carrying capacity has existed for a long-time and has been used in a wide range of fields and contexts. It has been used in several natural resource professions to measure rangeland productivity and to understand and increase the number of game species (Manning, 2007; Needham et al., 2013; Sayre, 2008). In this context, the concept of carrying capacity was based on the notion that an organism can survive only within a limited range of physical conditions (Carey, 1993). Since the 1960s the concept of carrying capacity has been employed in relation to the management of habitats and ecosystems (Seidl & Tisdell, 1999), but during the 1970s the concept expanded and was used in studies of outdoor recreation in United States national parks (Manning, 2007).

Carrying capacity in outdoor recreation is generally defined as the maximum number of visitors an area can accommodate without excessive deterioration on the environment or declining visitor satisfaction (Gonzalez-Guerrero et al., 2015; Lui, 2003; Manning & Lawson, 2002; McCool & Lime, 2001). The concept was first applied to national park management when increasing visitation started to become a concern (Kalisch, 2012). During the 1980s, the research reflected a shift from precise numbers (Graefe et al., 1984; Washburne, 1982) to an emphasis on management policies that met visitor expectations and preferences (Ferreira & Harmse, 2014). By the early 2000s the consensus was that carrying capacity is not fixed as it develops in time and the growth of tourism can be affected by management techniques and controls (Saveriades, 2000).

In the context of parks and protected areas, carrying capacity expanded into a three-dimensional concept that includes: environmental resources (ecological), the type and quality of the recreation experience (social), and the extent and direction of management action (managerial) (Manning & Lime, 1996). In light of tourism development, carrying capacity is concerned with the capability of the natural environment to withstand human use and the effects of visitors on the ecology of an area (Haider & Payne, 2009); experiences that visitors have in parks and protected areas (Haider & Payne, 2009; McCool & Lime, 2001) and the extent to which there are adequate facilities and the condition of infrastructure, such as bathrooms, signs and parking, that accommodate the needs of visitors (Needham & Rollins, 2009; Needham et al., 2013). The nature and degree of impacts generally depends on external factors, including use level, tourist behavior, type of tourist activities, management practices and investment, industry practices and development, weather, season of use, location of use, soil, geology, vegetation and topographic characteristics (McCool & Lime, 2001; Timothy & Boyd, 2015; Zelenka & Kacetl, 2014).

As research evolved it became evident that carrying capacity can be applied to almost any human-environment interaction at any scale (Sayre, 2008). There are also obvious parallels between carrying capacity and the concept of sustainability as both address the inherent tension between use of the environment and protection of its basic integrity (Manning, 2007). Establishing carrying capacities for tourism is a simple step in moving toward sustainable tourism because it calls for identifying limits and managing within them (McCool & Lime, 2001). However, it is important to acknowledge that carrying capacity is not fixed and is not exclusively a function of the number of visitors (Zelenka & Kacetl, 2014). Some important

variables to consider are: the distribution of visitors in the area, their activities, behavior and the state of tourism infrastructure (Zelenka & Kacetl, 2014).

Carrying capacity can be useful as a park and outdoor recreation management concept when viewed in proper perspective, which is as an organizing structure for analyzing, defining and managing appropriate recreation conditions (Manning, 2007). In its modern form, carrying capacity may offer an opportunity to confront the protection-use dilemma that is at the heart of managing parks and protected areas (Haider & Payne, 2009). There has been considerable research and countless case studies on the implications of carrying capacity in United States parks and protected areas, however minimal public research has been conducted in a Canadian context (Sayre, 2008).

2.4.1 Environmental

In national parks, environmental or ecological carrying capacity refers to the capability of the natural environment to withstand human use (Haider & Payne, 2009). It is exceeded when biophysical factors cannot withstand a certain level of use, which results in unacceptable changes to resource indicators, such as soil, vegetation, water or wildlife (Needham et al., 2013). The investigation of ecological carrying capacity can involve various techniques, such as identifying the effects of visitors on the ecology of an area or evaluating the impact of proposals for new developments in a park or protected area (Haider & Payne, 2009).

2.4.2 Social

The social carrying capacity focuses on the experiences that visitors have and the relationships among users in parks and protected areas (Haider & Payne, 2009). For example, a visitor's experience may be negatively influenced by too many other people, people who are different in their interests or by people who are too different in their behaviors (Haider & Payne,

2009). It identifies the level of use beyond which social impacts, such as crowding and/or conflict, exceed acceptable levels specified by evaluative standards (Needham et al., 2013).

The social dimensions of carrying capacity can be examined using different variables. Many studies of carrying capacity have focused on use levels or encounters and the concept of crowding. There was increased need for research on crowding during the 1950s because of the large increase in visitation to some parks and protected areas (McCool & Lime, 2001). Crowding and encounters are subjective evaluations of visitor use levels (Needham & Rollins, 2009) and descriptions of the number of other visitors or objectives that individuals remember seeing during a trip or at a given location (Bell et al., 2011; Vaske & Donnelly, 2002).

Crowding is considered a significant factor that can influence the outcome of recreation participation and satisfaction (Leujak & Ormond, 2007; Manning & Anderson, 2012; Needham & Rollins, 2009). Perceptions of crowding are often influenced by use levels, site characteristics, personal characteristics of visitors and visitor activities (Leujak & Ormond, 2007; Manning, 1999; Vaske & Donnelly, 2002). According to Leujak and Ormond (2007), crowding norms appear to be strongly dependent on expectations as visitors feel crowded when they encounter more people than expected. Therefore, when evaluating crowding it is important to evaluate expectations and encounters, while also taking into consideration additional factors that could influence the overall satisfaction of visitors.

Conflict is another factor that can influence the satisfaction of visitors (Needham & Rollins, 2009). Conflict is identified as the rise between recreation groups and those participating in different types of activities (Needham & Rollins, 2009; Manning & Anderson, 2012). There are different types of conflict that can occur between people participating in similar or different types or styles of outdoor recreation. One-way conflict occurs when one activity group

experiences conflict with or dislikes another group but the conflict is not mutual (Needham & Rollins, 2009). For example, a study of snowmobilers and cross-country skiers in Alberta showed that skiers disliked encounters with snowmobilers but snowmobilers did not mind skiers (Vaske et al., 2007). Two-way conflict occurs when there is resentment in both directions (Needham & Rollins, 2009). For example, downhill skiers and snowboarders (Vaske et al., 2000; Thapa & Graefe, 2003). Interpersonal conflict occurs when the presence or behavior of an individual or group interferes with goals or expectations from another individual or group (Needham & Rollins, 2009; Manning & Anderson, 2012). Conflict can be influenced by lifestyle tolerance, degree of activity expertise, level of connection to a park or particular place, importance of natural environment to an activity, visitor expectations and perception of safety (Manning & Anderson, 2012). Individuals or groups are more likely to experience conflict when they place more importance on the activity and have well-defined goals, objectives and expectations (Needham & Rollins, 2009).

2.4.3 Managerial

The managerial carrying capacity identifies the extent to which there are adequate facilities and the condition of infrastructure, such as bathrooms, signs and parking, that accommodate the needs of visitors (Needham & Rollins, 2009; Needham et al., 2013). Certain areas within parks and protected areas may receive heavier visitation than others and require more attention, such as attraction sites, trails, campgrounds, roads and interpretive facilities (Manning & Anderson, 2012. The first approach to understanding the managerial carrying capacity is to use a descriptive landscape design and monitor the actual use patterns (Needham et al., 2013). This approach helps determine supply and demand thresholds, physical space, use patterns and performance of site features to facilitates and services in recreational setting

(Needham et al., 2013). The second approach is subjective and evaluative as it focuses on the importance of facilities to users and their satisfaction with the number and/or the condition of the amenities, facilities and infrastructure or services provided (Needham et al., 2013).

2.5 Limits of Acceptable Change

Early applications of the carrying capacity concept in recreation often sought to establish a number or capacity across dimensions of a setting (Needham et al., 2013). The limits of acceptable change (LAC) framework was initially developed to address and overcome the emerging debate about how to manage carrying capacity (Diedrich et al., 2011). LAC shifts from focusing on visitor numbers to emphasizing setting quality and reframes the fundamental question of "how much use is too much or how many is too many" to "how much use or impact is acceptable or should be allowed" (McCool, 2013; Needham et al., 2013). LAC acknowledges that outdoor recreation will cause changes in park resources and/or the quality of the visitor experience, but suggests that limits must be defined on the amount of change that is acceptable (Manning & Anderson, 2012). Therefore, it aims to establish the relationship between existing or desired or acceptable conditions (Ahn et al., 2002). In its simplest form, LAC is a process for determining the resource or social conditions that are acceptable and then prescribing a set of management actions to achieve those conditions (Eagles & McCool, 2002).

LAC is a structured and adaptive process for deriving transparent and defensible management plans (Needham et al., 2016b), but relies heavily on management judgement for implementing suitable strategies where problems are identified (Ahn et al., 2002). This framework uses environmental, social and managerial indicators as measures to reveal standards of quality or thresholds where conditions become unacceptable or should not be allowed (Needham et al., 2013). It also emphasizes that planning and management should be

participatory by involving evaluations by stakeholders, such as users or visitors (Manning, 2011).

Park managers are faced with the challenge of integrating the conflicting goals of providing access while at the same time preserving the natural values of the park and/or protected area (McCool, 2013). LAC provides a way of thinking about and responding to these challenges (McCool & Lime, 2001). The nine steps, outlined in Figure 1, guide managers and researchers so that not only can desired baseline conditions of a resource area be determined but necessary indicators and standards can be put in place to enable recognition of when degradation or too much change has occurred (Frauman & Banks, 2011).

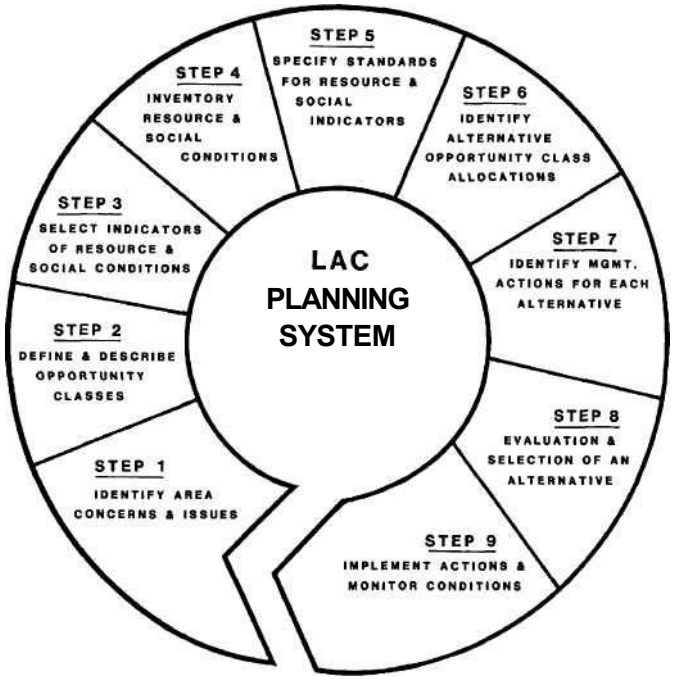

Figure 1: The limits of acceptable change (LAC) framework.

Source: Stankey et al., 1985

2.6 Consumer Behavior

Consumer behavior involves certain decisions, activities, and ideas or experiences that satisfy consumer needs and wants (Solomon, 1996). In tourism specifically, consumer behavior can be defined as the ensemble of the acts, attitudes and decisions regarding choosing, buying and consuming tourism products and services, as well as, post-consuming reactions (Fratu, 2011). In addition, it is an important issue for marketing activities, which have the sole purpose of promoting and selling tourism products (Fratu, 2011). Therefore, understanding consumer behavior is important for developing new tourism products and services because it offers a clearer view of what consumers are looking for (Fratu, 2011). The need to understand consumer behavior will continue to increase as climate change impacts tourist destinations and products.

2.6.1 Tourist Decision-Making

Tourist decision-making is inherently complex because consumers make multiple decisions about several elements of their vacation itinerary, some of which are made prior to arrival, while others are made while at the destination (Choi et al, 2012; Cohen et al., 2014; Decrop & Snelders, 2004; Hyde & Lawson, 2003). The complexity of this can only be fully captured by focusing on the process of tourist decision-making (Cohen et al., 2014). It is often assumed that travel decisions are thoroughly planned but travel has become a frequent activity for some with less emphasis being placed on the planning process (Cohen et al., 2014). Therefore, further examination of the routine aspects of travel decisions are required because both new and previously visited destinations or travel products are involved in the decision-making process (Cohen et al., 2014).

2.6.2 Tourist Perceptions

Tourist perceptions are understood as the "process of receiving and interpreting information through all senses" (Gossling et al., 2006, 423). Perceptions are not only important in the tourist decision-making process but also in influencing the actual outcome of the individual traveler's personal feeling toward reported or experienced change (Gossling et al., 2012). Tourist perceptions of environmental change are particularly important for destinations that are sensitive to climatic change because of the role they play in tourist decision-making (Gossling et al., 2012; Gossling & Hall, 2006a; Hall & Lew, 2009; Scott, 2006a; Scott et al., 2008). Climate directly impacts when specific recreation and tourism activities can occur (e.g. season length), demand (e.g. proportion of people willing to swim and camp under certain conditions), and quality of experience (e.g. hiking in warm sunny conditions or cold rainy conditions or extreme heat) (Scott et al., 2007).

Understanding tourist perceptions and reactions to the impacts of climate change is therefore essential to anticipating the potential geographic and seasonal shifts in tourism demand, changes in specific tourism markets, and the overall competitiveness of business and destinations (Gossling et al., 2012). However, tourist perceptions and responses to environmental change are not well understood and there is very little understanding of how adaptations may change the way potential visitors perceive destinations and whether these changes in perceptions are likely to result in significant changes in visitor behavior (Gossling et al., 2012; Gossling & Hall, 2006a; Jopp et al., 2015; Scott, 2008; Scott et al., 2012a). The characteristics and issues surrounding tourist's perceptions of climate change are outlined in Table 1. Understanding the behavior of future tourists and how the media shapes perceptions of tourism under various climate scenarios and the consequences this has for behavior and destination choice is an important conceptual

barrier (Scott et al., 2007; Gossling et al., 2012). Further investigation into the underlying reasons behind preferences for various adaptation options and assessment of long-term environmental changes on destination choice in a Canadian context would help destinations overcome the negative implications of climate change (Gossling et al., 2012; Jopp et al., 2015).

Table 1: Characteristics and issues surrounding tourist's perceptions of climate change impacts.

Climate Change Impacts	
• Perceptions vary by holiday type and role • Perceptions change with age, culture and other socio-demographic variables • There are considerable differences in individual preferences, values and personalities • Perceptions evolve over travel careers and with the degree of specialization • Perception is comparative • There are significant differences between ex-situ and in-situ perceptions • Perceptions are heavily influenced by media • The media will increase interest in 'last chance' tourism	• Single events can have wide-ranging consequences for perceptions • Perceptions are complex, adaptive and hierarchical • Perceptions are context-dependent • The accurateness of the understanding of climate variables and resources (e.g. weather parameters) is insufficiently understood • Adaptive behaviour is insufficiently understood • Public perceptions of climate change can be ill-informed and highly polarized

Source: Gossling et al., 2012.

2.7 The Behavioral Approach

The behavioral approach proposes that people engage in specific activities in certain settings to fulfill motivations and realize a group of benefits that are known, expected and valued (Manning, 1999). It suggests that visitor's behavior can be understood in terms of motivations, psychological goals that develop from these motivations, and how activities and settings facilitate the achievement of these goals and generate satisfaction (Needham et al., 2016b). The behavioral approach links visitor satisfaction with conditions and experiences, which can be influenced by cognitions such as values, beliefs and attitudes (Needham et al., 2016b). By

understanding relationships among visitor cognitions, park managers may be able to predict further behavior and anticipate support or opposition toward management decisions (Needham et al., 2016b). The behavioral approach has three components: visitor motivations and expectations, actual experiences, and visitor satisfaction.

2.7.1 Visitor Motivations

The first component of the behavioral approach involves motivations, which are generally referred to as reasons for visiting an area or participating in an activity at a given time (Manfredo et al., 1996). More specifically, it is defined as "psychological/biological needs and wants, including integral forces that arouse, direct and integrate a person's behavior and activity' (Yoon & Uysal, 2005, 46). Motivations are identified by asking visitors what needs they seek to satisfy (Needham et al., 2016b) and can include internal factors that are pushing people to engage in activities or external characteristics of activities and settings pulling people to select activities or settings (Mannell, 1999).

Iso-Ahola (1989) proposed that there are two motivational dimensions influencing behavior, one is seeking (e.g. approach) and the second is escaping (e.g. avoidance) (Needham et al., 2016b). Seeking involves the search for personal and interpersonal benefits from leisure, such as challenge, learning, social contact, and connectedness, whereas escape focuses on the constraining nature of life (e.g. work, routine, stress) and the need for experiences optimizing arousal (Needham et al., 2016b). The recreation experience preference (REP) scale was developed within the context of motivation theory and contains more than 300 motivations that have been reduced to 19 domains, of which eight are important to most visitors in parks: exploration, nature experience, exercise, exhilaration, escape from role overload, introspection,

time with similar people, and an escape from physical stressors (Manfredo et al., 1996; Needham et al., 2016b).

In the tourism literature, the key factors involved in travel motivation and destination choice are identified as: climate, natural environment, income and discretionary wealth, personal safety and travel costs (Gossling et al., 2012; Hall, 2005). In addition, destinations appeal to tourists for several reasons, including their uniqueness, perceived authenticity, tourist resources (e.g. climate, travel time and travel cost), perceived safety and security, existing facilities, services and access, and host hospitality (Gossling et al., 2012; Hall, 2005). Therefore, if a visitor has selected a destination or site for a given holiday or leisure activity, it has met motivational demands and provides satisfactory experiences (Gossling et al., 2012). Motives for travel are interlinked with destination attributes and the greatest uncertainty is represented by tourist's perception of change and some motivations will be affected positively or negatively by climate change, while others remain unaffected (Gossling et al., 2012).

2.7.2 Experiences and Expectations

The second component of the behavioral approach involves actual experiences that follow these motivations, which are characterized as the interactions between activities and settings (Needham et al., 2016b). Settings differ in appearance and character, and can be distinguished based on environmental (modern to primitive), social (isolated to crowded), and managerial conditions (few to many regulations) (Needham et al., 2016b). However, recreation is a dynamic, multi-phase experience consisting of not only these on-site experiences but also anticipation, travel-to, travel-back, and recollection phases (Needham et al., 2016b). Parks Canada has developed a visitor experience cycle, which outlines stages of experience as: wishing, planning, travelling, arriving, visiting and leaving (Needham et al., 2016b). Despite the

multiple phases, it is generally accepted that motivations initiate participation in activities and settings, and benefits, such as satisfaction, occur as a result of participation (Manning, 2011; Needham et al., 2016b).

Expectations are the desires or wants of consumers related to what consumers feel a service provider should offer (Cohen et al., 2014; Parasuraman et al., 1988). They often reflect the standard that consumers expect when evaluating attributes of the product/service offered (Cohen et al., 2014; Teas, 1993). Consumers typically perceive what they are expecting, which is usually based on familiarity, previous experience, values and motivations (Cohen et al., 2014; Schiffman & Kanuk, 1997). Expectancy theory suggests that participants engage in recreation activities with the expectation that this will fulfill selected needs, motivations, or other desired states (Manning, 2011). In regards to environmental change, the potential acceptance by tourists is related to the expectations that have been created in tourism promotional material as well as the product package (Gossling et al., 2012; Hall, 2008). Understanding visitors' characteristics, motivations and expectations is key to effective management policies (Eagles & McCool, 2002).

2.7.3 Satisfaction

The third component of the behavioral approach involves visitor responses in the form of benefits or outcomes, such as satisfaction (Needham et al., 2016b). Satisfaction is referred to as "positive perceptions or feelings that an individual forms, elicits, or gains as a result of engaging in leisure activities and choices; it is the degree to which one is content or pleased with his or her general leisure experiences" (Beard & Ragheb, 1980, 22). In other words, it is the congruence between expectations, motivations and outcomes (Manning, 2011; Needham et al., 2016b).

Visitor satisfaction is one of the most common indicators of recreation quality (Vaske, 2008). An individual's satisfaction is complex and dependent upon a variety of aspects related to

the experience, including one's expectations and motivations (Vaske, 2008). It is a multidimensional concept, affected by a number of potential variables, such as environmental conditions, use level, facility development, and weather, and some are under the control of management and some are not (Manning, 2011). Situational variables, such as resource, social and management setting and subjective evaluations, such as socioeconomic characteristics, cultural characteristics, experience, attitudes and preferences, and norms affect the overall satisfaction (Manning, 2011; Whisman & Hollenhorst, 1998). In addition, it involves both internal and external factors; internal are shaped by motivations and experiences, and external involve setting attributes (Jackson, 1989; Needham et al., 2016b). Therefore, a visitor's satisfaction is complex as they may be satisfied or dissatisfied with different aspects of an activity and/or setting and examining satisfaction within various aspects of settings and experiences can produce more meaningful insights compared to a single overall measure of satisfaction (Needham et al., 2016b).

2.8 Tourism and Adaptation

Adaptation is a technique that can be used to overcome the negative implications of climate change. The Intergovernmental Panel on Climate Change (2007) defines adaptation as, "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". Thus, adaptation refers to the ability of a unit (e.g. a tourism operator or a community) to transform its structure, operations or organization to survive under changes (e.g. climate change) threatening its existence and success (Kajan & Saarinen, 2013). Adaptation can be pursued by societies, institutions, individuals, governments and can be motivated by economic, social or environmental drivers (Adger et al., 2007).

In the tourism literature, adaptation is considered an appropriate response to reduce the industry's vulnerability to climate change (Becken & Hay, 2007; Kajan & Saarinen, 2013; Patterson et al., 2006). Climate adaptations are rarely undertaken in isolation but involve multiple components that are specific to the destination climate and its tourism products (Simpson et al., 2008). The UNWTO-UNEP-WMO (2008) provide an extensive list of options for adaptation responses in mountain and winter tourism destinations as well as the nature-based tourism industry (Table 2). Churchill, Manitoba has traditionally been known as the polar bear capital of the world but they have begun diversifying and promoting themselves as a beluga whale watching spot, birder's paradise and a place to experience the northern lights. Ski resorts have increasingly been investing in alternative non-skiing activities that can include: snowmobiling, indoor pools, and health and wellness spas. Although several of the adaptation options in Table 2 are attractive, many would be hard to implement in Canadian national parks due to policies and mandates related to ecological integrity. Additionally, many of the adaptation options would require extensive management planning and exploration that may not be feasible under budgetary constraints.

Turton et al. (2010) identified that the adoption of adaptation strategies will require the following: (1) confidence that the climate is really changing and that increased variability in climate is part of the process; (2) motivation to avoid risk or take up opportunities; (3) demonstration of new technologies; (4) transitional and legislative support from the government; (5) resources from the government and private stakeholders; and (6) effective monitoring and evaluation. The emergence of planning frameworks, such as limits to acceptable change, has provided park agencies with opportunities to find alternative management actions that are acceptable and ensure that standards are not violated (McCool & Lime, 2001). However,

implementing adaptations or policies is difficult because of the complexity of the tourism sector and the high level of interdependence with other sectors (Csete & Szecsi, 2015).

Tourism operators are constantly evolving and adapting to various externalities, including climate variability, and there has been limited research conducted to investigate tourists' opinions regarding specific adaptation options, with perhaps one exception being the ski industry (Jopp et al., 2015). The main barriers to adaptation in tourism are: uncertainty over climate change science among industry stakeholders, the long timeframes of climate change impacts are incompatible with business planning, and inadequate technical, human resource and financial capacity (Scott et al., 2012a). In tourism specifically, adaptation is challenging because of the scale of change and interconnectedness, translating adaptive capacity into action, current adaptive actions are not sustainable (market-led rather than community based) and successful adaptation is highly contextual (Adger & Barnett, 2009; Kajan & Saarinen, 2013).

Very little research has been conducted on the particular impacts of climate change adaptation measures on tourist attitudes and behavior (Jopp et al., 2015). There is a lack of research that assesses the impact of long-term environmental changes on destination choice (Gossling et al., 2012; Jopp et al., 2015). Despite the relatively good understanding of the types of climate change adaptation measures available and in use, there is still very little understanding of how these adaptations may change the way that potential visitors perceive destinations and, further whether these changes in perception are likely to result in significant changes in visitor behavior (Jopp et al., 2015). Knowing how the tourists will react to changes in destinations can be an effective way of assisting destinations in taking adaptation measures, especially because destinations are under pressure to adapt their operations in order to stay attractive if climate-induced changes occur in the tourism system (Kajan & Saarinen, 2013).

Table 2: Options for adaptation responses in mountain and winter tourism destinations and the nature-based tourism industry.

Mountain and Winter Tourism	Nature-Based Tourism
• Stimulate product and seasonal diversification e.g. creating spas, all-year tourism • Implement snow-making, and make it more efficient • Groom ski slopes to reduce snow depth requirements • Preserve glacier areas • Move ski areas to higher altitudes or to colder north slopes • Improve insurance cover in the face of extreme events and natural disasters (e.g. avalanches) • Promote industry partnerships (integration within resorts, cooperation between resorts) to reduce economic vulnerability and share the cost of snow-making • Educate and raise awareness among tourists about the impacts of global environmental change on the Alpine landscape • Combine mitigation and adaptation measures into integrated and coherent strategies • Improve water use and protect Alpine watersheds • Improve emergency preparedness, implement and improve warning and evacuation systems and put avalanche prevention infrastructure into place	• Develop response plans • Improve adaptive capacity of authorities and managers of protected areas through capacity building initiatives • Establish scientific monitoring survey programmes to assess ecosystem changes and take necessary protection measures • Promote product diversification, for example: opening up new 'micro destinations' and attractions within and adjacent to an already popular national park or heritage site; diversification is especially important where key elements of the nature-based product are threatened • Carry out re-design or redefinition of protected areas • Reduce or remove external stresses such as pollution and in the case of marine resources, agricultural run-off • Promote the application of integrated tourism carrying capacity assessment techniques • Improve visitors and congestion management to prevent overuse of sites and physical impacts of visitation • Promote mitigation options amongst environmentally conscious eco-tourists • Ensure active participation of local communities living within or near protected areas, in policy making and management processes • Take into consideration local and traditional knowledge to develop coping and adaptation strategies • Develop replicable methodologies and share knowledge across nature-based destinations

Source: UNWTO-UNEP-WMO, 2008.

2.8.1 Adaptive Capacity

Adaptive capacity is defined as "the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC, 2014b, 1758). The adaptive capacity determines the success of the design and implementation of effective adaptation strategies that reduce the likelihood and magnitude of harmful outcomes resulting from climate change (Brooks & Adger, 2005) or enables sectors and institutions to take advantage of opportunities or benefits from climate change (Adger et al., 2007). In general, the adaptive capacity of the tourism industry to climate change is insufficiently understood (Gossling et al., 2012) and is difficult to determine because tourists have the opportunity to stay away from destinations impacted by climate change (Csete & Szecsi, 2015).

The capacity to adapt to climate change varies between the components of the tourism value chain, which are: tourists, tourism service supplies, destination communities, tour operators, and sub-sectors of tourism industry (Becken & Hay 2007; Elsasser & Bürki 2002, Gossling & Hall 2006b; Scott, 2006b; Simpson et al., 2008). Adaptive capacity in parks and protected areas is largely determined by factors other than climate change, including access to financial resources, human capital and political will, and it is important to understand how such external factors influence park manager's ability to adapt (Lemieux et al., 2010).

Tourists are considered to have the greatest capacity to adapt to the risks and opportunities posed by climate change because unlike most tourism stakeholders, tourists have the ability to decide when and where to go and what activities to engage in (Gossling et al., 2012; Jopp et al., 2015; Scott et al., 2008). For instance, tourists may learn to accept new conditions, adjust their perception of acceptable or preferred environmental conditions, or focus on a different set of activities supported by prevailing environmental conditions (Gossling et al.,

2012). Their adaptive capacity depends on three key resources: money, knowledge and time (Simpson et al., 2008).

On the other hand, tourism service supplies and operators at specific destinations have lower adaptive capacity but destination communities and tourism operators with large investments in immobile capital assets (hotel, resorts, marina, or casinos) have the least adaptive capacity (Simpson et al., 2008). Large tour operators, who do not own the infrastructure, are in a better position to adapt to changes because they can respond to clients demands and provide information to influence clients' travel choices (Simpson et al., 2008). It has been suggested that the tourism industry overall has a relatively high adaptive capacity because of its dynamic nature and ability to cope with shocks such as, SARS, terrorism attacks or natural disasters (UNWTO-UNEP-WMO, 2008). However, tourism managers and policy-makers appear to be neglecting the vital role that the tourists themselves might play in response to climate change, through their choice of holiday destination (Jopp et al., 2015).

2.9 Scenario Planning

Scenario planning was adopted as a business-planning tool in the 1970s to better understand the consequences of extreme and complex situations as well as the potential outcomes of different development pathways (Gossling & Scott, 2012). Scenario planning has been used in climate change research for dealing with its various impacts, and for comparing the effectiveness and efficiency of various mitigation and adaptation strategies (Carlsen et al., 2013). It has also been recognized as a useful methodology for exploring changes in social-ecological systems in connection with decision-making (Carlsen et al., 2013). Page et al. (2010) acknowledge that creating long-term scenarios allows tourism researchers to think more long-term alongside the developments in futures research from management science and other areas.

The central idea of scenario planning considers a variety of possible futures that emphasis on uncertainties rather than focusing on the accurate prediction of a single outcome (Peterson et al., 2003). It is based on formulating narrative descriptions of alternative hypothetical futures as a way to overcome bias views of the world and help managers prepare for developments that cannot necessarily be anticipated (Daconto & Sherpa, 2010). The overall management purpose of scenario planning is to assess the long-term implications of current decisions and options and to explore pathways of change and unexpected outcomes (Daconto & Sherpa, 2010).

The methodology behind scenario planning usually relies on qualitative techniques but can be combined with quantitative analysis to fully explore a wide set of alternative futures (Baron et al., 2009; Bradfield et al., 2005; Carpenter, 2002; Daconto & Sherpa, 2010; Peterson et al., 2003; Raskin, 2005). The concept generally involves two phases: the creation of scenarios and the presentation of scenarios. The most common approach to deriving scenarios is through the development of narratives and workshops with stakeholders (Carlsen et al., 2013; Daconto & Sherpa, 2010; Ernst & van Riemsdijk, 2013; Evans, 2011; Page et al., 2010; Tompkins et al., 2008) with the resulting data being presented using charts and tables, plans, maps, drawings, photographs or GIS-based models (Tress & Tress, 2003).

The advantage of scenario planning is that it helps question existing beliefs, attitudes and worldviews of participants but can also reveal unanticipated insights and ideas (Rickards et al., 2014). Tools and techniques like scenario planning will become increasingly important in tourism if destinations are going to address what needs to be done to remain and enhance their competitiveness (Page et al., 2010). However, the main problem with scenario planning in tourism is that much of the work is confidential and there is a lack of documented and researched

publications in this field, which makes it hard to understand what has been done previously and how it was done (Yeoman & McMahon-Beattie, 2005).

2.10 Environmental and Landscape Visualizations

Visualizations are not a new phenomenon as maps, drawings and data plots have been used for over a thousand years (Al-Kodmany, 2001). The use of computer-based visualizations began in the early 1980s but became widespread in the mid-to-late 1990s as they became an increasingly important tool in generating more meaningful and successful public involvement (Lewis et al., 2012). The role of visualizations has greatly increased as expectations of computer graphics has also increased and visual literacy has evolved (Manore, 2007). Visualization research has two main strands, the first is the simulation models that provide numeric and graphic representations of system function and change, and the second is environmental visualizations that are predicted on the "look" of environmental change (Hughes, 2005).

Simulation modeling was the first strand of visualization research and is typically used to describe complex dynamic systems such as ecological, geological and climatic processes (Lewis et al., 2012). In this type of modelling, the real world is often simplified and its characteristics are changed based on "what if" scenarios to analyze and identify preferred outcomes (Ervin, 1992). Whereas, environmental visualizations are graphic depictions of real places from a particular perspective that can be manipulated to show features of importance or conditions based on management (Sheppard et al., 2004). Most are derived from workstation computer programs that created colour images of landscapes (Lewis et al., 2012). The potential for environmental visualizations was realized in the early 1990s by resource management and environmental design professionals (Lewis et al., 2012) and emerged as a distinct field of academic research and as a contributor to professional planning and decision-making (Bishop &

Hull, 1991; Bishop & Leahy, 1989; Daniel, 1992; Lewis et al., 2012; Oh, 1994). Appleton & Lovett (2003) state that visual communication is an increasingly common part of environmental decision-making, which is important because scientific research has indicated that humans are inherently visual (Al-Kodmany, 2001).

Environmental visualizations have evolved and emerged into a tool that is often used to represent climate change (Sheppard et al., 2011). A study conducted by Sheppard et al. (2011) found that when using environmental visualizations to represent climate change, participants indicated a substantial increase in their understanding of the urgency of responding to climate change. They are also beneficial because of their capacity for realism (Appleton & Lovett, 2005) but it is important that they are portrayed in an accurate and realistic way because over-amplification or exaggeration can reduce the belief in the likelihood of extreme events caused by climate change (Lowe et al., 2005). Therefore, Lewis et al. (2012) argued that defensibility is critical in producing visualizations of climate change impacts. To achieve fair and effective visualizations they need to be: comprehensible, representative, accurate, credible and defensible, engaging and accessible (Sheppard, 1989; Sheppard, 2001; Sheppard et al., 2004).

Landscape visualizations are used for planning and decision making because visual or scenic qualities are major components of an encounter with the natural environment (Al-Kodmany, 1999; Clay & Daniel, 2000; Nicholson-Cole, 2005). Several researchers have established the validity of landscape visualization as a tool for illustrating environmental change or determining landscape preferences (Appleton & Lovett, 2003; Bergen et al., 1995; Bishop & Rohrmann, 2003; Bishop et al., 2013; Lange, 2001). The most common methodology has been to compare the responses to computer-generated images and either the real environment (Bishop &

Rohrmann, 2003), photographs (Bergen et al., 1995; Lange, 2001), or other computer-generated imagery (Appleton & Lovett, 2003).

Digital photomontage is an emerging approach that often uses image manipulation software, such as Photoshop (Dockerty et al., 2006). This approach requires a base-line landscape photograph, scenario(s) of how the view will be altered and suitable imagery to incorporate into the photomontage to represent the scenario (Dockerty et al., 2006). Previous studies (Al-Kodmany, 1999; Simpson et al., 1997) have used this approach for visualizing policy options. A key benefit to this technique is that once an image library has been created, it is convenient and straightforward for a skilled person using the appropriate software to produce representations of altered landscapes, making it transferable and possible to evaluate impacts and landscape change at any location where information exists (Dockerty et al., 2006). Sheppard (2004) hypothesized that certain kinds of visual communication, such as landscape visualizations, improve public awareness on the complexities and implications of climate change and may help motivate behavioral change at individual to societal levels. However, when using visualization it is important to acknowledge that they are just illustrations and have no analytical capacity and are limited to the field of view obtained in the original image (Dockerty et al., 2006). Furthermore, the image can provide only a single view of a landscape and are simply plausible representations of possible futures (Dockerty et al., 2006).

Landscape visualizations are mostly used as an attempt to illustrate potential futures. The presentation of alternative future landscapes has emerged as a way of conveying policy options, reflecting the benefits that visualizations can provide in terms of communicating information and engaging communities in the policy development process (Lovett, 2005; Orland et al., 2001). This type of research models and/or visualizes future landscapes, also known as “futurescapes”,

to assist and/or influence decision-making on a management or planning issue (Lovett, 2005). They tend to involve a mixed-method approach with components of: GIS, scenarios and/or modelling tools, prediction of future landscape characteristics, production of maps and/or 3D visualizations of future landscapes and assessment of visual images as communication device and a means of support decision making on landscape management or wider environmental issues (Lovett, 2005). Visualizations of landscape change combined with scenario techniques enables planners, decision makers, researchers and stakeholders to grasp the possible impact of alternative developments (Tress & Tress, 2003).

The local climate change visioning project (LCCVP) developed a framework that addresses the multiple challenges of creating and visualizing climate change scenarios (Sheppard et al., 2011). It attempts to integrate the best available science at global, regional and local scales, local GIS mapping, and stakeholder knowledge to visualize potential climate change impacts in a clear and compelling way, and to present possible policy and behavioral choices for communities (Sheppard et al., 2011). The framework allows the possible effects of different levels of response to climate change to be articulated and enables researchers to connect the dots between global scenarios and local storylines (Sheppard et al., 2011). The LCCVP framework has been used to create visualizations of sea level rise and snowline retreat, which linked climate change, physical science and landscape representation with GIS, remote sensing, and visualization processing (Sheppard et al., 2011). There is considerable potential for visual learning tools as they allow researchers to illustrate scenarios in an engaging way to stakeholders (Sheppard et al., 2011).

Chapter 3: Methods

3.1 Introduction

The following chapter will describe the methodology used in this study. The case study will be introduced and the development of the visualizations will be explained. An overview will be provided of the survey design and the sampling strategy used during data collection. The chapter will conclude with a description of the data analysis used to generate results and the main limitations experienced during this research.

3.2 Case Study: The Athabasca Glacier

Case study research involves the analysis of a single instance in order to explore in-depth nuances of the phenomenon and to better understand and sometimes directly resolve problems (Baxter, 2010). It is a valuable approach because it can produce deep, concrete explanations of social phenomenon that are attentive to a variety of contextual influences at various scales (Baxter, 2010). This research will take a case study approach to examine the relationship between visitor satisfaction and adaptation at the Athabasca Glacier in Jasper national park (JNP). Jasper National Park is located along the Alberta and British Columbia boarder and remains an enduring symbol of the best that Canada has to offer the world with broad valleys, rugged mountains, glaciers, forests, alpine meadows and wild rivers (Parks Canada, 2010). It was established in 1911 making it the fifth national park in the Canadian Rocky Mountains and sixth national park in Canada. It is designated as one of Canada's seven mountain national parks and shares the designation of the Canadian Rocky Mountains Worlds Heritage Site with adjoining national and provincial parks. Jasper is the largest national park in the Canadian Rocky Mountains spanning 11,228 km^2 and has the second largest attendance among the seven mountain national parks and all national parks in Canada (Parks Canada, 2010). Jasper National

Park has a long history of conservation and tourism, which presents both challenges and opportunities in managing the long-term health of the park (Parks Canada, 2010).

Annual attendance to Jasper has varied over time with totals ranging from 1.6 million to over 2 million. In 2007-08 attendance to the park reached two million but the following year attendance decreased by over 180,000 (Parks Canada, 2012). Nonetheless, attendance increased each year from 2008-09 onward and by 2013-14 the park had reached two million visitors again. In 2015-16 Jasper hosted over two million visitors and accounted for 16% of the total attendance to all national parks (Table 3).

Table 3: Parks Canada attendance 2011-12 to 2015-16.

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**
Jasper National Park	1,958,206	1,993,139	2,019,100	2,167,469	2,266,072
Seven Mountain Parks*	7,201,152	7,339,978	7,334,558	7,977,977	8,554,610
Total**	12,529,627	12,722,828	12,723,434	13,520,886	14,469,008

*Jasper, Banff, Yoho, Kootenay, Mount Revelstoke, Glacier and Waterton Lakes.
**National parks, park reserves & marine conservation areas in Canada.
Source: Parks Canada, 2016

The Icefields Parkway extends 230 km between the Town of Jasper and Lake Louise in Banff National Park and hosts approximately 400,000 vehicles per year (Luckman & Kavanagh, 2000; Parks Canada, 2010). The Athabasca Glacier is a significant point of interest along the parkway and is situated across from the Columbia Icefield Centre in Jasper National Park. The Columbia Icefield Centre is open from mid-April to mid-October offering various services such as: paid tours, Parks Canada information, restaurants, washrooms and accommodations.

Figure 2: View of Athabasca Glacier site features from the glacier looking onto the Icefield Parkway.

The Athabasca Glacier is the most heavily used day-use area in Jasper National Park and is the most accessible and visited glacier in North America (Parks Canada, 2014). The glacier is host to over one million day-use visitors per year (Luckman et al., 1999). Tourists can experience the glacier by hiking or through a paid commercial tour. The main hiking trail to the toe of the glacier is ~1.8 km return and accessible from the glacier parking lot. However, all access onto the glacier from this trail is strictly prohibited and extremely dangerous because of potential hidden crevasses. Therefore, the only way to step foot onto the glacier is through the IceWalk or Glacier Adventure tour. IceWalk has been offering guided interpretive hikes onto the glacier seasonally since 1985 and Brewster has been operating motorized tours onto the glacier since 1969. Brewster has developed into a multi-dimensional tourism operator as they have multiple attractions throughout the Rocky Mountains, such as the glacier adventure tour, glacier skywalk, Banff gondola, Banff lake cruise and Malign lake cruise. The glacier adventure tour began with snowmobiles but has evolved into a fleet of all-terrain Ice Explorers, which can transport up to

56 passengers onto the glacier (Brewster, 2016). It has been estimated that over 600,000 tourists per season experience the glacier via the Ice Explorer (Luckman & Kavanagh, 2000).

Climate-induced environmental change has been documented in several mountain regions worldwide that are key tourists destinations, including sites in the European Alps, Rockies, Andes, and Himalayas (Welling et al., 2015). The Athabasca Glacier is no exception as it has been receding for the last 125 years, has lost half its volume, and has retreated more than 1.5 km (Parks Canada, 2014). Hugenholtz et al. (2008) compared photographs of the glacier from 1917 and 2006, which illustrated retreat of ~1 km and a decrease in the height and width of the glacier. Additionally, several aspects of the proglacial landscape have changed over the past 89 years, most notably: deposition of a series of terminal moraine ridges; the development of Sunwapta lake in the early 1940s; exposure of large bedrock outcrop along the valley floor; and changes in vegetation cover (Hugenholtz et al., 2008; Luckman & Kavanagh, 2000).

More changes are inventible as twenty-first-century climate scenarios project that by 2050 mean annual temperatures in the Canadian Columbia basin will increase by 1.8°C to 2.7°C compared to 1971-2000 (Murdock et al., 2013). Additionally, by 2100 it is estimated that the volume of glacier ice in western Canada will shrink by 70% ± 10% relative to 2005 (Clarke et al., 2015). This is significant as glaciers are tourist attractions throughout the Rocky Mountains and any change in glacier extent, snow cover, proglacial lakes and vegetation may impact visitor facilities and tourist safety (Luckman & Kavanagh, 2000).

3.3 Development of Visualizations

Groulx et al. (2016b) developed climate futurescapes of the Athabasca Glacier in 2050 depicting potential impacts and adaptations using the LCCVP narrative downscaling approach. The potential impacts illustrated in the climate futurescape visualizations included changes in

glacial mass-volume, snow cover, debris cover, foreground vegetation, and the potential development of a proglacial lake and stream system (Hart, 2006; Hugenholtz et al., 2008; Luckman & Kavanagh, 2000; Tennant & Menounos, 2013). The estimate of glacial retreat was developed using work from Clarke et al. (2015), which was determined to be an additional two kilometers. Similar to succession patterns in the region, by 2050 new vegetation, including species like Engelmann spruce, Rocky Mountain fir, White pine, Buffaloberry, and Shrubby Cinquefoil would have started to establish themselves in the foreground and valleys of the retreating glacier. Adaptation options were developed, such as the introduction of a footbridge and roped fence, the extension of current walking paths, the adaptation of roads that currently support snocoach tours and addition of helicopter tours. Groulx et al. (2016b) created six images in Adobe Photoshop CS5 using photographs of representative viewpoints and a photomontage technique (Sheppard, 2001). The narratives and environmental visualizations were reviewed by three glaciologists and twelve tourism and climate change experts. Feedback from climate change and tourism experts indicated that the proposed adaptations did not anticipate a wide enough range of potential adaptation options.

Therefore, the foundation for this research began with the work done by Groulx et al. (2016b). The climate futurescapes visualizations were used as baseline imagery to enable the development and visualization of new and expansive adaptation scenarios with input from tourism experts.

3.3.1 Approach

The limits of acceptable change framework and scenario planning tool were vital in guiding the development of the tourism development scenarios. The limits of acceptable change framework was used to structure this research (Table 4) and the scenario planning tool was used

to create meaningful storylines (Table 5). Carlsen et al. (2013) developed a scenario-planning tool intended to provide a methodology for incorporating socioeconomic development paths into the local climate change adaptation process. Although this research does not incorporate socioeconomic aspects, the bottom-up approach is applicable to the integrity of this research as the intended users are local policy and decision-makers.

To aid the development of scenarios for this research a matrix approach was used, whereby four scenarios corresponding to values for each driver and four envisaged future states were created. The drivers were plotted on an orthogonal axis and the scenarios corresponded to extreme values for each driver (Daconto & Sherpa, 2010). The 2x2 matrix approach was selected because it is a clear, memorable and easy to communicate structure that allows the subsequent scenario storylines to be comparable (Ramirez & Wilkinson, 2014). The clarity of the matrix also makes it easy to communicate to those who are not involved in the scenario building process (Ramirez & Wilkinson, 2014). The 2x2 matrix and resulting four scenarios were selected because moving beyond that can result in having more scenarios than can be used or interpreted (Ramirez & Wilkinson, 2014). Since the scenarios involved visitors, it was increasingly important to consider the respondents and a reasonable number of scenarios to avoid fatigue. Additionally, the 2x2 approach has been stated by researchers to be the "standard" approach in scenario planning (Ramirez & Wilkinson, 2014).

Each proposed scenario has their own storyline and with a corresponding illustration (Table 6 and Figure 4). The baseline imagery was created by Groulx et al. (2016b), which reflects landscape change with an emphasis on glacier extent, snow cover, proglacial lakes and streams and vegetation. The environmental factors reflected in the baseline image remained the same for each scenario but the social and managerial factors varied according to scenario

parameters. Similar to Groulx et al. (2016b), a photomontage technique in Adobe Photoshop CS5 was used to create four visualizations from one viewpoint (credit: Sarah Brown). This approach allows for valuable insight into the future of glacier tourism at the Athabasca glacier and will contribute to the emerging literature on scenario planning, environmental visualizations, climate change and adaptation.

Table 4: Application of the limits of acceptable change framework.

Step	Application
Step 1: identify area concern and issues	**Area of Concern** Athabasca Glacier **Issues** Environment: climate-induced environmental change Social: crowding Management: facilities and infrastructure
Step 2: define and describe management objectives	**Parks Canada Mandate** "on behalf of the people of Canada, we protect and present nationally significant examples of Canada's natural and cultural heritage, and foster public understanding, appreciation and enjoyment in ways that ensure the ecological and commemorative integrity of these places for present and future generations" (Parks Canada, 2010) **Jasper National Park Vision Statement** "Jasper National Park is an enduring symbol of the best that Canada offers to the world – spectacular scenery, a pristine environment, a diverse sightseeing and recreational opportunities, welcoming hosts, vibrant Aboriginal and local culture, watchable wildlife and large wilderness" (Parks Canada, 2010) **Icefield Parkway Strategic Concept (2009)** One of the key directions states that "the parkway will reflect the three fundamental aspects of Parks Canada's mandate – education, experience and protection. Maintaining the ecological integrity, cultural resources and visual integrity of the setting are fundamental for memorable visitor experiences and opportunities to learn and to appreciate the natural surroundings" (Parks Canada, 2010).
Step 3: select indicators or resource and social conditions (Survey)	**Environmental Indicators** • Snow cover • Glacier extent • Proglacial lake and streams • Vegetation **Social Indicators** • Number of people **Managerial Indicators** • Facilities and infrastructure
Step 4: inventory resource and social conditions	Data collected in the field via visitor survey.
Step 5: specify standards for resource and social indicators	Standards will be identified once the data is collected.
Step 6: specify alternatives	Alternatives will be developed using a scenario planning approach.
Step 7: identify management actions for each alterative	Each scenario will incorporate and/or explore a different tourism development scenarios.
Step 8: evaluate and select an alternative	Scenarios will be visualized and evaluated by visitors through a survey.
Step 9: implement actions and monitor conditions	Parks Canada will be presented the results.

Table 5: Application of scenario planning tool.

Phase one: framing scenarios			
The purpose of using scenarios is threefold: 1. identify future challenges, both opportunities and threats, related to climate change 2. identify options for adaptation 3. assess options or combination of options for coping with challenges of climate change that arise in different scenarios			
Phase two: building scenarios			
A) Choosing the time frame For identifying challenges and adaptation options, a time frame of at least 20-50 years is recommended in order to focus on the long-term planning issues that area associated with a changing climate. Therefore, the time frame for this study is 2050 to ensure that the scenarios show real change and are not just an extension of the present.	**B) choosing a focal question** **Future challenges:** What challenges related to climate change and destination image may influence the tourism industry most within the next 33 years? **Options:** what adaptations are possible and important for the ability of stakeholders to deal with the impacts from future climate change? **Assess:** what level change based on the scenarios presented will mitigate negative consumer perceptions?	**C) creating key drivers and states** **Indicators:** *Environmental* (quality and condition of natural features at the site) *Social* (crowding) *Managerial* (facilities and infrastructure) Matrix approach, whereby there will be four scenarios.	**D) constructing scenario narratives** The scenarios should be focused on describing the relationship between the most important key drivers. A scenario is then constructed by choosing one state for each of the prioritized key drivers. The drivers of my scenarios will be commitment to ecological integrity and visitor demand. Therefore, each of the scenarios will have a different degree of tourism development and visitor demand.
Phase three: using the scenarios			
A) Identifying future challenges Climate induced environmental change will result in changes to the landscape, such as glacial extent, snow cover and vegetation. Additionally, changes in the landscape may present challenges for stakeholders operating the glacier currently.	**B) Identify options** Adaptations will be influenced by previous research. The proposed facilities and infrastructure: helicopter tours (Stewart et al., 2016); tram (Kim et al., 2014; Canoe and Kayaking (Purdle, 2013); interpretive material.	**C) Assess adaptation options** The adaptations and overall scenarios will be assessed through visitor surveys.	

Adapted from Carlsen et al., 2013.

3.3.2 Future Tourism Development Scenarios Storylines

Table 6: Future tourism development scenarios at the Athabasca Glacier for 2050 storylines.

Environmental Conditions
The glacier remains an iconic Canadian landscape despite significant changes to environmental conditions at the site. Rate of retreat increases as a result of climate changes in the region. A mean annual temperature increase between 1.8°C – 2.7°C, a 1% - 9% increase in annual precipitation, and a 1.5 – 3.3-fold increase in the number of warm days (compared to a 1970-2000 baseline). Compared to the ~1.5 kilometers that the glacier receded between 1890 and 2014, the glacier has receded ~ 2 additional kilometers. Outwash produced because of glacial melting and retreat have led to the formation of a sizable pro-glacial lake and numerous pro-glacial streams. These features have developed as deep basins in the bedrock that were established during retreat, and subsequently filled with melt-water and sediment. For many visitors these water features are aesthetically pleasing and have become an attraction in their own right. They have also created new logistical challenges for Parks Canada and tourism operators. In addition to these changes, the glacier has developed more pronounced moraine walls, thicker debris cover, and increasingly complex and rugged topography. The debris that is continually left behind as a result of increased melting has also affected the colour of the glacier. Similar to other successional vegetation patterns in the region, new vegetation, including species like Engelmann spruce (*Picea engelmannii*), Rocky Mountain fir (*Abies lasiocarpa*), White pine (*Pinus albicaulis*), Willow (*Salix sp*.), Buffaloberry (*Sheperdia Canadensis*), and Shrubby Cinquefoil (*Potentilla fruticosa*) have started to establish themselves in the foreground and valleys of the retreating glacier.

Scenario One: *positive visitor response; moderate to low commitment to ecological integrity*
Social
Vulnerability continues to increase as the physical resource continues to diminish in quality. The popularity of the site is maintained because different economic activities, such as canoe and kayak rental services, are embraced (Dawson et al., 2011). A new demographic of visitors, such as eco-tourists, are attracted to the site, as it is no longer dominated by thrill seeking and commercial activities. Demand remains stable and may even increase for the time being because the diminishing glacier is overshadowed by new attractions.
Management
Parks Canada attempts to balance their commitment to ecological integrity and visitor experience. Existing services, such as Glacier Adventure Tours and Glacier IceWalk Tours are maintained for revenue retention purposes as demand remains strong, but additional large-scale infrastructure projects are prohibited. The scale of the Glacier Adventure Tours operation is reduced, which means less snocoachs are travelling onto the glacier than in previous years. The formation of pro-glacial lakes and streams has the potential to represent attractive features that could compensate for the diminishing glacier (Haeberli & Hohmann, 2008; Frey et al., 2010; Garavaglia et al., 2012). These features provide the foundation for new opportunities for glacier tourism at the site. Therefore, to enhance visitor experience, canoe and kayak rental services were established, similar to those offered at Lake Louise in Banff National Park. Interpretation at the site is improved through the addition of educational signage and Parks Canada representatives maintain their post at the Columbia Icefield Centre.

Scenario Two: *negative visitor response; low commitment to ecological integrity*
Social
Vulnerability continues to increase at the site as the physical resource continues to diminish in quality and investment in glacier tourism activities continues to increase. Demand rapidly increases because different economic activities, such as canoe and kayak rental services, helicopter tours and tram services are embraced (Dawson et al., 2011). The site experiences mass tourism and crowding becomes a prominent issue. In addition, conflict between users emerges, as recreationists who seek solitude and nature-based activities begin to feel displaced with all the commercial development that has occurred at this site. Demand remains increasingly high but there is concern that interest may decrease over time as the glacier continues to retreats.
Management
Parks Canada focuses heavily on visitor experience and maintenance of ecological integrity becomes a low priority. They are compelled to move in this direction for revenue retention and acquisition purposes. Existing services, such as Glacier Adventure Tours and Glacier IceWalk Tours remain a prominent attractor to the site. Private operators maintain a strong presence and massive capital infrastructure projects, such as helicopter tours and the development of a tram, are approved to facilitate visitor experiences in an attempt to maintain and improve revenue streams. Interpretation at the site is improved through educational signage, while Parks Canada representatives maintain their post at the Columbia Icefield Centre. The Columbia Icefield Centre is accredited as the adventure hub within the park. Since the site is one of the most popular day-use areas in the park, it is important for Parks Canada to retain and continue to profit from this site in order to invest and fund conservation initiatives elsewhere.

Scenario Three: *positive visitor response; moderate to high commitment to ecological integrity*
Social
Vulnerability continues to increase as the physical resource is diminishing. The popularity of the site has decreased over time due to loss of interest in the tourism marketplace because the Glacier Adventure Tours are no longer operational (Dawson et al., 2011). Parks Canada does everything they can to promote the site as an educational experience and encourage tourists to still visit the site in hopes to maintain revenue. However, demand and revenue slowly diminish as the glacier continues to retreat.
Management
Parks Canada strives to maintains their commitment to ecological integrity. Although visitor experience remains a priority it is no longer maintained at the expense of ecological integrity. Traditional glacier features have been lost as much of the former route that was used to transport visitors onto the glacier by the Glacier Adventure Tours has been lost. As a result, the site has shifted from a focus on adventure tourism towards educational tourism. Parks Canada made a decision to rely on existing glacier resource to enhance the quality of the glacier experience rather than developing new experiences (Wang & Jiao, 2012). Interpretation became the main priority at the site with the establishment of personal and non-personal interpretation. IceWalk Tours onto the glacier are still offered with the addition of guided hikes around the glacier site led by interpreters provided by Parks Canada for a small fee. During peak time periods, such as weekends and holidays, point duty interpreters are stationed at the trailhead parking lot to informally interpret or answer questions. Additionally, signage about climate change, glaciers, sustainability and environmental change are displayed throughout the site to provide visitors with information and educational material. Parks Canada has also introduced a shuttle service that provides transportation services from the town of Banff and town of Jasper to the Athabasca Glacier several times a day in an effort to reduce the number of cars on the icefields parkway and the carbon footprint of the park.

Scenario Four: *negative visitor response; high commitment to ecological integrity*
Social
Vulnerability continues to increase as the physical resource is diminishing. Investment in the glacier is minimal due to Parks Canadas strong commitment to ecological integrity. Private operators began retreating from the site due to lower demand and financial reasons. Demand is dramatically reduced in response to a declining supply as services offered at the site are phased out (Dawson et al., 2011) and the glacier continues to diminish in quality. As a result, the main attraction at the site becomes the Columbia Icefield Centre.
Management
Parks Canada maintains a high level of commitment to ecological integrity and resource protection and visitation is no longer considered a priority. Parks Canada maintains that their main priority is to protect the natural identity of the site. They declared that it is no longer safe to operate the Glacier Adventure Tours or Glacier IceWalk Tours and no other commercial activities are to be pursued. The trail to the toe of the glacier is maintained and bridges are developed to allow access but educational material along the trail is not considered a priority. Instead, visitors are encouraged to enjoy the museum and educational material provided at the Columbia Icefield Centre. Parks Canada developed various exhibits and interactive activities that can be enjoyed at the centre alongside Parks Canada representatives. This initiative is inspired by the Norwegian Glacier Museum and Ulltveit-Moe Climate Centre. A glacier museum can display glacier landscapes, glacier information and protection, and also raise tourists' awareness of ecotourism, low-carbon tourism and environment protection (Wang & Jiao, 2012). Additionally, several tower views (telescopes) are installed at the centre for better viewing of the glacier.

3.3.3 Visualizations

Figure 3: Current and future landscape at the Athabasca Glacier. Credit: Sarah Brown.

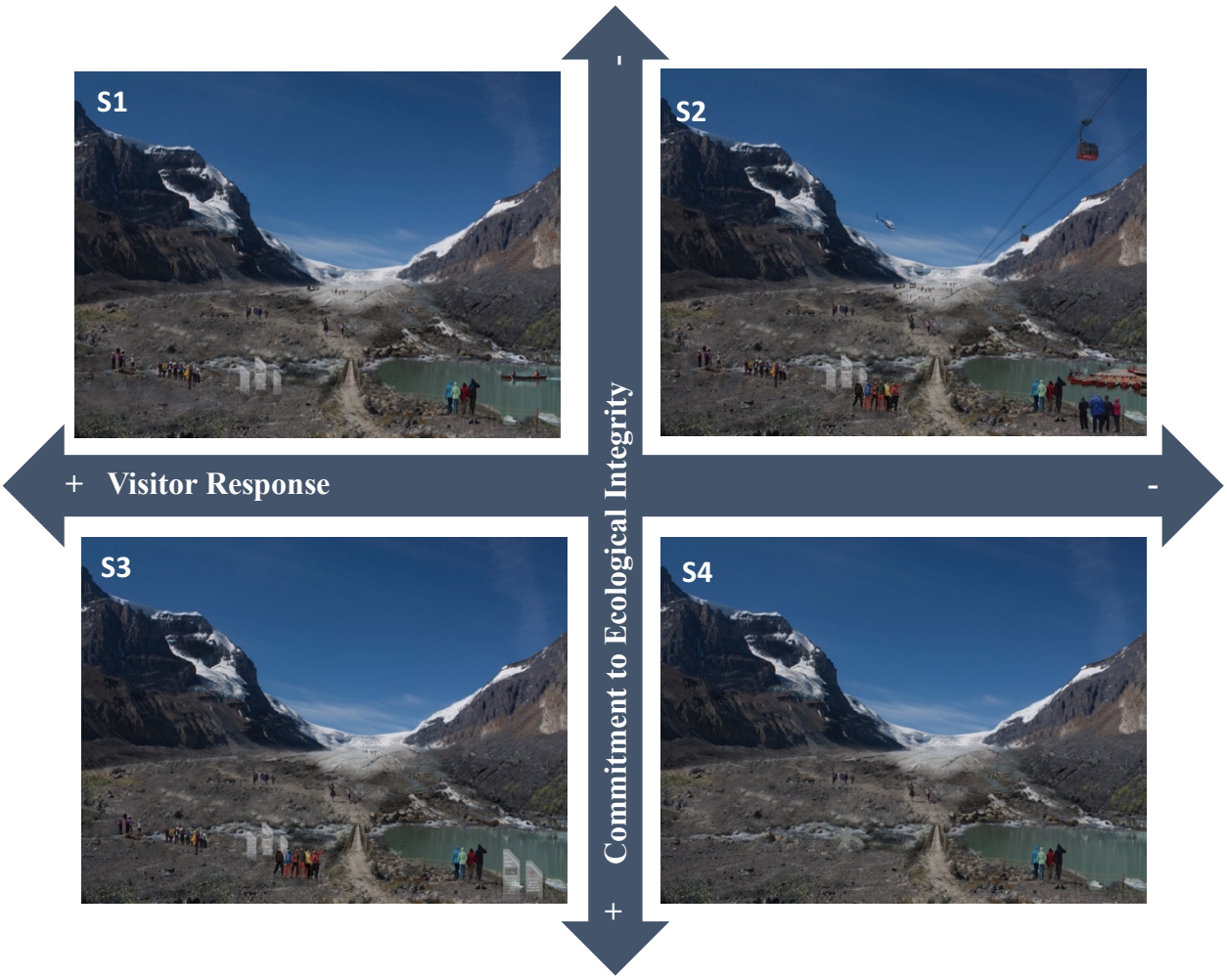

Figure 4: Visualizations of the future tourism development scenarios at the Athabasca Glacier for 2050. Credit Sarah Brown.

Note: see Appendix B for larger images.

3.4 Survey Design

The survey used in this study included seven separate sections that focused on a range of topics. The first section inquired about the nature of each participant's trip and the second section investigated motivational factors using a five-point likert scale (5 = extremely important; 1 = not at all important) (Manfredo et al., 1996). The travel motivation scale was adapted from the recreation experience preference (REP) instrument and previous research conducted by Groulx et al. (2016a) and Wilson et al. (2014). The third section asked visitors about their expectations and

satisfaction with the current visitor experience. Visitors were also asked to report the number of encounters with other visitors during their visit (1 = <10; 6 = >90) and the extent of crowding. Heberlein & Vaske (1977) developed a question that asks visitors to indicate the extent of crowding using a nine-point scale. The rationale behind this nine-point scale is that it needs to be sensitive enough to pick up even slight degrees of crowding as a smaller scale or yes or no scale could lead people to just say no (Vaske, 2008). The single-item indicator of crowding has proven to be intuitively meaningful for both researchers and managers (Shelby & Vaske, 2007; Vaske, 2008; Vaske & Shelby, 2008) and since 1975, has been used in 181 studies resulting in crowding ratings for 615 different settings and activities and 85,451 individuals have been asked this question (Vaske, 2008; Vaske & Shelby, 2008).

The fourth section focused on the Athabasca Glacier in 2050 and measured visitor's satisfaction with future environmental conditions and tourism development scenarios using a five-point likert scale. Visitors were asked to indicate their satisfaction with future environmental conditions: snow cover, glacier extent, proglacial lakes and streams and vegetation. For each tourism development scenario, visitors were asked to indicate their satisfaction with the number of people, facilities and infrastructure provided to facilitate glacier viewing experiences, and overall visitor experience at the glacier site. These evaluations were visitors' responses to the visualization images. The fifth section presented plausible management actions that could be implemented in Jasper National Park based on the current conditions and asked visitors to indicated their acceptability using a five-point likert scale. In the sixth section, three general questions about climate change were used from past studies examining public perceptions of climate change (Groulx et al., 2016b; Roser-Renouf et al., 2014; Van der Linden, 2015). The

final section included visitor demographic questions, such as age, gender, citizenship, education and annual household income.

3.5 Data Collection and Sampling Strategy

Data was collected at the Athabasca Glacier site from July 26 – August 3, 2016 and August 31 – September 2, 2016. During the primary data collection (July 26th – August 3rd) period two Samsung Galaxy View tablets were used with an 18.4" display. During the second data collection period four iPad tablets with a 9.7" display were used in addition to the two Samsung Galaxy View tablets. Data was collected on the tablets using Harvest Your Data mobile data collection software that is compatible with both apple and android devices. To overcome the potential glare associated with tablets and the small screen size of the iPads, laminated booklets (8.5" x 14") with the visualizations were provided as supplementary material. Tourists were approached using a systematic random sampling approach as several scholars have acknowledged that this approach to on-site surveys is less subject to selection errors by field researchers (Vaske, 2008; Babbie, 2003; Scheaffer et al., 1996; Thompson, 1992). Adult tourists were approached as they were exiting the trail to the toe of the glacier and were asked to complete an electronic copy of the survey on a tablet computer. Before 11 am, every other person was approached and after 11 am every third person was approached.

The primary data collection period took place from July 26th to August 3rd where 202 surveys were collected with a 55% response rate. An additional 113 surveys were collected from August 31 to September 2, which yielded a 44% response rate. Therefore, a total of 315 surveys were collected during the two data collection periods rendering a response rate of 50% (Table 7). Groulx et al. (2016b) generated the same response rate when conducting surveys at the Athabasca Glacier previously. Responses rates in parks and protected areas tend to vary across

studies, for example, on-site surveys in Kenai Fjords National Park generated a response rate of 89% (Brownlee et al., 2013) and in Churchill, Manitoba generated a response rate of 84% (Dawson et al., 2010) and 71% (Groulx et al., 2016a). Mail-return surveys administered in Waterton Lakes National Park generated a response rate of 53%. According to Babbie (2003) a 50% response rate is considered adequate and 60% and above is considered good. Research suggests that survey response rates tend to be declining over time for many social science studies and parks, recreation and human dimensions of natural resource studies, particularly those that use mail-return surveys or telephone surveys (e.g. Connelly et al., 2003; Cook et al., 2000; Krosnick, 1999; Steeh, 1981; Steeh et al., 2001). The response rate can be influenced by the topic, number and personalization of contacts, time of survey administration, question complexity and questionnaire design (Vaske, 2008).

Of the 318 visitors that declined to participate, 47% stated that they did not have enough time, 14% could not speak or were not proficient in English, and 26% did not provide a reason. Other reasons provided were: they had family waiting, a dog in the car, were part of a bus tour and the weather.

Table 7: Number of participants who were approached, completed or declined to participate.

	Number approached	**Number completed**	**Number declined**	**Response Rate (%)**
Jul 26 – Aug 3	370	202	168	55
Aug 31 – Sep 2	263	113	150	43
Total	633	315	318	50

A total of 11 participants were removed during data cleaning for missing data that exceeded 15% of the survey or for unengaged responses, which left a final analyzable sample of 304 visitors. Most survey items contained fewer than 1% missing values and many contained less than 0.7%, except for eight items that contained between 1.3% and 1.6% missing data.

Missing data can occur for a variety of reasons, such as accidently missing questions or participants may exert their right not to answer a question (Field, 2013). Tabachnick & Fidell (2013) acknowledge that when missing values are randomly scattered throughout a data set they pose less serious problems. They also state that when only a few data points, 5% or less, are missing from a large data set, the problems are less serious and almost any procedure for handling missing values yields similar results (Tabachnick & Fidell, 2013). If missing values are scattered throughout cases and variables, deletion of cases can mean substantial loss of subjects, which is why a missing value analysis was performed for this data (Tabachnick & Fidell, 2013). It was determined that the variables were missing completely at random and subsequently a missing value regression analysis was performed because it is a more objective approach than inserting the mean (Tabachnick & Fidell, 2013). This approach uses cases with complete data to generate an equation, which it uses to predict missing values for incomplete cases (Tabachnick & Fidell, 2013). The regression analysis was performed on a scale by scale basis to ensure greater accuracy, whereby the data was divided into five clusters: motivation, expectations, satisfaction (C4, D 1, 2, 4, 6, 8), likelihood (D 3, 5, 7, 9), and management. A missing value analysis was not performed on the demographic data.

A glitch was noted in the survey software for question C2 and C3 regarding how many visitors were encountered and the extent of crowding. By default the scale was set at four (51-70) for encounters and five for crowding but if the scale was not moved by the participant, then the software resorted to "null". As a result, it was assumed that the respondents whose answer was "null" agreed with where the scale was placed and the answers were changed from "null" to four (51-70) and five respectively. This glitch affected 61 respondents for question C2 regarding encounters and 48 respondents for question C3 regarding crowding.

The electronic delivery of self-administered survey questionnaires has been found to generate more accurate results than those obtained with paper survey questionnaires (Belisario et al., 2015; Gwaltney, 2008; Lane, 2006) and tend to result in higher item response rates than paper surveys (Belisario et al., 2015; Bowling, 2005). They can also reduce errors by skipping questions irrelevant to subjects based on previous responses (i.e. skip/flow logic) thereby simplifying portions of the survey for subjects and ensuring that individuals do not answer sections that should be left unanswered (Singleton et al., 2011). Therefore, explaining why the dataset collected in this study is relatively clean.

3.6 Data Analysis

Descriptive statistics and correlation analyses were produced in SPSS (v. 24) to understand the data collected from the visitor survey. Descriptive statistics were initially used to understand visitor perceptions of climate change, crowding and proposed management actions. To fulfil objective one and understand the factors that influence visitor satisfaction, a spearman correlation was performed using the behavioral approach as the theoretical foundation. The spearman correlation is a non-parametric correlation that is based on the ranks of the data rather than the actual values (Vaske, 2008). This type of analysis is appropriate for ordinal values, such as those collected using a likert scale (Vaske, 2008). The variables selected for the correlation corresponded to the behavioral approach, which are: motivations, expectations and experiences (environmental, social and managerial).

An exploratory factor analysis (EFA) was used to reduce the eleven motivation variables into a smaller number of factors. Principle axis factoring was selected as the EFA method, which requires that each successive factor accounts for the maximum possible amount of variance common to a group of variables while also not correlating with any factor extracted previously

(Briggs et al., 1986). Direct-oblimin was selected as the rotation and factors were accepted if their eigenvalues were greater than one and if the scree plot confirmed the solution. An item was considered meaningful to a factor if its loading was above 0.40 (Stevens, 2009). The reliability of the EFA was measured using the Cronbach's Alpha and Spearman-Brown formulas. Cronbach's Alpha was used for the first factor as there are more than two variables. It is generally believed that a value of .70 or .80 is an acceptable value for Cronbach's Alpha and that values substantially lower indicate an unreliable scale (Field, 2013). However, an alpha of .65 to .70 is considered an adequate scale in parks, recreation and human dimensions' research (Vaske, 2008). When a scale only has two variables it is recommended that the Spearman-Brown formula be used to estimate the reliability (Eisinga et al., 2013; Hulin et al., 2001). This formula is referred to as a split-half reliability, whereby it splits the scale set into two randomly selected sets of items (Fields, 2013). A score is calculated for each half of the scale and if the scale is reliable, the score on each half should be the same (Fields, 2013).

To achieve objective two and identify the relationship between satisfaction with the current visitor experience and future tourism development scenarios, descriptive statistics were reported. The percentage of satisfied or very satisfied visitors was identified for the overall experience, environmental, social, and managerial conditions for the current and future tourism development scenarios. The data was from the current experience was then compared to the data collected for the future tourism development scenarios to determine the relationship.

3.7 Limitations

The main limitations of this study are associated with sampling. This research only focused on one segment of the tourist population at the Athabasca Glacier site. Due to Parks Canada research permit restrictions, only visitors at the glacier parking lot were surveyed after they hiked the trail to the toe of the glacier. Therefore, any visitors who only went to the Columbia Icefield Centre across the street and participated in commercial tours, such as the snocoach tour and glacier skywalk, were not surveyed.

Similar to Stewart et al. (2016) it is also possible that segments of international tourists were underrepresented due to language barriers. This is important to note because many of these tourists travelled a very long distance to experience the Rocky Mountains and their opinions are valuable in understanding the future of tourism at the Athabasca Glacier. Consequently, the results provide insight into how climate-induced environmental change may influence visitor experience from the perspective of those who visited the trail to the toe of the Athabasca glacier and were proficient in English.

Visitor surveys were administered at the site using computer tablets with limited technological errors. Participants were keen to use the tablets and on-site administration allowed for on-the-spot clarification if visitors had any questions. The survey was composed of only closed-ended questions. The main advantage to quantitative research is that it allows researchers to draw conclusions from a larger number of people while investigating the relationships that exist within the data (Creswell, 2015). Surveys also allow for representative data and increase the ability to generalize findings (Vaske, 2008). However, the main disadvantages of quantitative research are: on-site administration of surveys are less flexible because once the survey is finalized changes can become costly (Vaske, 2008) and surveys provide a limited understanding

of the participants and does not record their words or opinions (Creswell, 2015). It is also unclear how much of each scenario was interpreted by a respondent, as they were presented without any explanation and data was collected using only closed-ended questions (Gossling et al., 2012).

The visitor survey was developed with the intention of comparability to Parks Canada and previous research conducted by Groulx et al. (2016b) and Stewart et al. (2016). It is an inherent strength as the results can be compared and contrasted to previous work but it must also be acknowledged as a potential weakness. For example, Parks Canada has adopted the explorer quotient toolkit, which classifies visitors into nine different categories rather than traditional or simplistic classifications, such as backcountry vs. frontcountry visitors. The explorer quotient involves a twenty-question quiz that allows visitors to determine which classification they fall into. For this reason, rather than determining the "type" of visitor that was surveyed, the emphasis was placed on the motivates of that visitor. The survey also had to be a reasonable length because surveying can be difficult at sites like the Athabasca Glacier where tourists are in a rush. This can be identified as a limitation because only essential questions could be asked, rather than additional exploratory questions.

Chapter 4: Results

4.1 Introduction

The results from the visitor survey will be presented in four sections. The first section will outline visitor characteristics. The second section will focus on visitor perceptions of climate change, crowding and management action. The third section will present results for objective one, to understand the factors that influence visitor satisfaction for the current experience and future tourism development scenarios. Finally, the fourth section will present the results for objective two, which will identify the relationship between satisfaction with the current experience and future tourism development scenarios.

4.2 Visitor Characteristics

The sample was composed of an almost balanced ratio of females (54%) and males (46%) with visitors ranging in age from 18 to 73 ($\overline{x}$ =38) and over half (62%) of the sample represented participants under the age of 40. Nearly half of the respondents (48%) had an annual income above $78,000, which is the median family income in Canada (Statistics Canada, 2016). The respondents were well educated as 28% had a bachelor's degree and 40% had a degree above the bachelor's level. Parks Canada (2010) indicated that approximately half of park visitors to Jasper are international, which is consistent with this sample as 68% reported that they are not Canadian citizens and 65% reside outside of Canada. International visitors resided in nineteen different countries worldwide with the most visits occurring from the United States (*n* = 76); the United Kingdom (*n* = 25); Australia (*n* = 19); Netherlands (*n* = 12); and Germany (*n* = 11). A total of 116 visitors indicated that their permanent residence was in Canada with most visiting from British Columbia (*n* = 35); Alberta (*n* = 32); Ontario (*n* = 24) and Quebec (*n* = 15).

According to Parks Canada (2014b), the Columbia Icefield Centre and the Athabasca Glacier are the most popular stops along the parkway and 53% indicated they had or would be visiting the Columbia Icefield Centre. For over half the visitors (68%) this was their first visit to the glacier and 81% stated they would be staying more than one night in Jasper National Park.

4.3 Perceptions of Carrying Capacity Issues

4.3.1 Perceptions of Climate Change

Most visitors at the Athabasca Glacier were somewhat sure (13%) or very sure (79%) that climate change is happening and that climate change is caused by the combination of human activities and natural changes (55%) or human activities (39%). Most visitors acknowledged that they were moderately (34%) or extremely (45%) concerned about the issue of climate change.

4.3.2 Perceptions of Crowding

According to Manning (2011), crowding has become one of the most frequently studied issues in outdoor recreation. The nine-point crowding scale has been used by several researchers but analysis of the scale varies across studies based on the context. Collapsing the nine-point scale into not crowded (1 and 2) vs. some degree of crowding (3 through 9) is too strict for this analysis, therefore the scale is collapsed into not at all and slightly crowded (1 to 4) vs. moderately and extremely crowded (5 through 9) (Vaske et al., 1996; Vaske, 2008).

Sampling occurred during the peak summer season and the levels presented in the results are likely rare in the shoulder season. Parks Canada acknowledge that roughly 75% of visitation to all national parks occurs from June to September (Parks Canada, 2015a). The average visitor reported that they encountered 51-70 people and felt slightly crowded. The correlation between reported encounters and perceived crowding was positive ($r = .4$, $p < .01$) indicating that as the number of encounters increases or decreases, visitor's perception of crowding increases or

decreases conversely. This relationship was not substantial nor was it weak. According to Vaske (2008), a typical relationship has a Pearson *r* of .3 but a substantial relationship has Pearson *r* of .5 or greater. Therefore, the relationship between crowding and satisfaction was substantial, indicating that as crowding increases, satisfaction decreases (Table 8). When asked to report their satisfaction with the number of people at the site, 44% indicated that they were satisfied and 34% disagreed with the statement "I expected there to be more people at the site". This supports the idea that crowding is dependent on expectations and encounters (Leujak & Ormond, 2007).

Table 8: Pearson correlation of encounters, crowding, expectations and satisfaction.

	1	2	3
1.Encounter			
2.Crowding	0.398**		
3.Expectation	-0.278**	-0.254**	
4.Satisfaction	-0.319**	-0.472**	0.262**

**Correlation is significant at the 0.01 level (2-tailed).

The percentage of visitors who felt moderately to extremely crowded varied based on the time (Figure 5) and date that they visited the glacier. Perceptions of crowding were highest (57%) from 1:00 pm to 3:00 pm and lowest (32%) from 9:00 am to 11:00 am. Visitors surveyed from July 26th to August 3rd felt more crowded than those surveyed from August 31st to September 1st. During the first data collection periods, there were five days (July 26, 27, 31, August 1 and 3) where over 50% of visitors indicated that they felt moderately to extremely crowded. Of the remaining four days, there were two (July 28th and August 2nd) days when 45% and 44% of visitors indicated that they felt moderately to extremely crowded. The other two days (July 29th and July 30th) had the lowest reported crowding evaluation (32% and 23%) among all data collection dates and corresponded with extremely poor weather conditions. During the second data collection period, only 38% and 39% of visitors felt moderately to extremely crowded on August 31st and September 1st. Due to poor weather conditions on the one weekend

surveying took place, no conclusions could be drawn between visitation on a weekday versus a weekend.

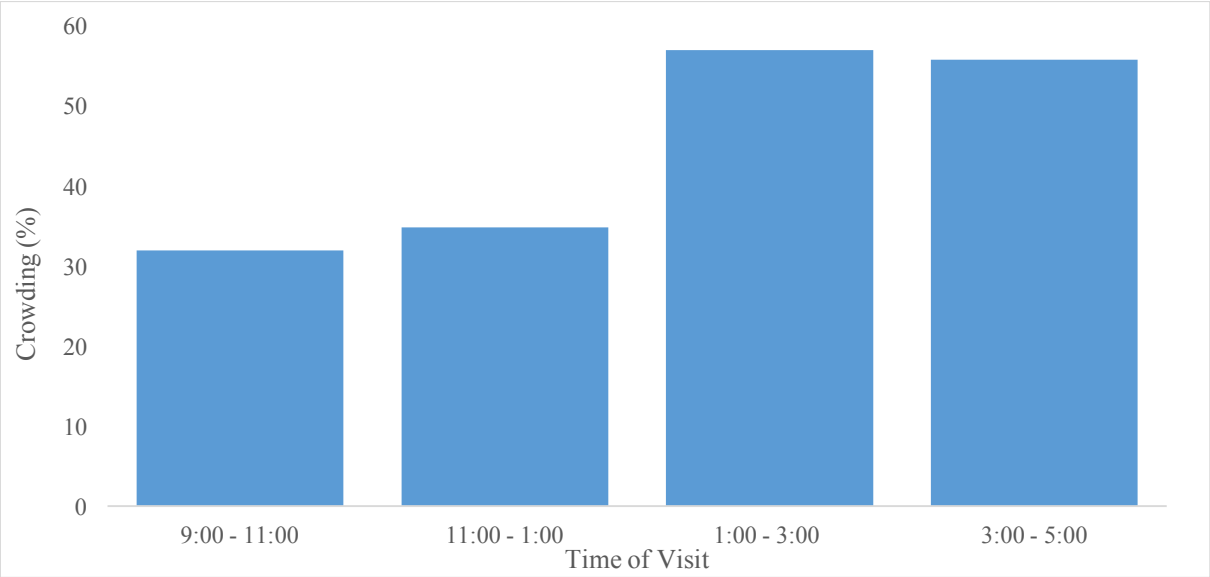

Figure 5: Percent of visitors that felt moderately to extremely crowded at the Athabasca Glacier according to time of visit.

4.3.3 Perceptions of Managerial Action

Visitors were asked to indicate the acceptability of seven proposed management actions based on the current visitor experience (Table 9). The proposed management actions were selected based on potential climate change adaptation strategies that have been proposed, discussed or implemented in tourism destinations. The results in Table 9 indicate that permanently closing the site from all visitation was considered unacceptable to visitors. Whereas, implementing a citizen science program was considered very acceptable among visitors.

Table 9: Percentage of visitors who indicated proposed management actions were acceptable or very acceptable and the mean evaluation.

Proposed Management Action	Acceptable or Very Acceptable (%)	Mean Evaluation
1. Limit access to the glacier (e.g. the number of users that can enter the site)	67	Acceptable
2. Development of another site for glacier visitation	59	Acceptable
3. Development of a certified park guided interpretive trail with educational programming on climate change (e.g. using signs to help guide visitors to interesting features that might otherwise be overlooked or not fully appreciated	83	Acceptable
4. Limit access to the site by privatized group tours with certified guides	40	Neutral
5. Permanently close the site from all visitation	14	Unacceptable
6. Provide a transportation system to provide more sustainable access to the glacier (e.g. shuttle bus from the town of Jasper or Banff)	42	Neutral
7. Implement citizen science program to engage the public in climate change issues and help collect data (e.g. establish a website that provides information and data on various environmental changes occurring at the glacier)	78	Acceptable

Note: measured on five point likert scale (1 = very unacceptable; 5 = very acceptable)

4.4 Influential Factors on Visitation with Current and Future Experiences

The theoretical basis for this analysis was rooted in the behavioral approach, which states that recreation-related behavior is goal oriented and participation is inspired by motivations and experiences (Manning, 2011). For this reason, the correlation matrix included motivations, expectations, and experiences (environmental, social, managerial and overall experience). Before the correlation matrix was developed, the motivation factors were derived using an exploratory factor analysis. The survey contained eleven motivation variables, which were reduced to two factors: learning and sharing. This will be explained in the subsequent section, followed by the correlation results.

4.4.1 Exploratory Factor Analysis of Motivation Variables

An exploratory factor analysis was used because it seeks to describe and summarize data by grouping together variables that are correlated (Tabachnick & Fidell, 2013). After removing items below the 0.40 threshold, six of the eleven motivation items loaded on two separate factors in the EFA (Table 10). This factor model explained 72% of the variance in the original data. Factor one included four items capturing a desire to learn, reflect and connect to the environment, which was titled learning. Factor two included two items capturing a desire to share and experience the destination and was titled sharing. The following factors were not included in the model because they were below the 0.40 threshold: to develop personal, spiritual values, to experience a sense of discovery, to share what I have experienced with others, to feel like I was one of the last people to view the glaciers here, and to be able to view an easily accessible glacier.

Table 10: Exploratory factor analysis of motivation factors.

Items	Factor 1 loadings	Factor 2 loadings
To reflect on how humans are impacting the environment	0.96	
To learn about the impacts of climate change on glaciers	0.81	
To feel connected to an environment that may not exist in the future	0.71	
To learn about glaciers	0.61	
To have a story to tell		0.70
To experience places I have read about		0.67
Initial eigenvalues	3.02	1.32
Rotated sum of squared loadings	2.58	1.32
Cronbach's Alpha reliability	0.86	
Spearman-Brown coefficient		
Equal Length		0.65
Unequal Length		0.65

4.4.2 Current Experience

The spearman correlation results (Appendix C) reveal that facilities and infrastructure had the highest correlation with overall satisfaction (r_s = .394, p <.001). This implies that facilities and infrastructure are the most influential factor in determining overall satisfaction at the Athabasca Glacier site. It is important to acknowledge that snow cover, glacier extent and proglacial lakes and streams also had a high correlation with overall satisfaction. All the predictors, except for "I expected there to be more facilities and infrastructure" had a positive relationship with overall satisfaction. The results also indicate that as expectations regarding facilities are not met, satisfaction will subsequently decrease. Expectations regarding the number of people had the weakest relationship with overall satisfaction, followed by the two motivational factors.

4.4.3 Future Tourism Development Scenarios

The spearman correlation results (Appendix C) for the four future tourism development scenarios indicated that two variables were highly correlated with overall satisfaction. The two variables were: facilities and infrastructure (S1 r_s = .695, p <.001; S2 r_s = .810, p <.001; S3 r_s = .803, p <.001; S4 r_s = .813, p <.001) and the number of people (S1 r_s = .620, p <.001; S2 r_s = .700, p <.001; S3 r_s = .704, p <.001; S4 r_s = .750, p <.001). The correlation between the number of people and facilities and infrastructure increased substantially for all four scenarios compared to the current experience. Coincidentally, the correlation between the environmental factors and overall satisfaction decreased for the four tourism development scenarios when compared to the current experience. Nonetheless, facilities and infrastructure and the number of people at the site had the greatest influence on overall satisfaction, not the environmental conditions.

4.5 The Relationship Between Satisfaction with Current and Future Experiences

To better understand how visitors might respond to environmental change at the Athabasca Glacier satisfaction with various elements of the current experience was compared to satisfaction with the four tourism development scenarios.

Visitors at the Athabasca Glacier site indicated that they were more satisfied with the current experience than the four tourism development scenarios (Figure 6). Scenario four had the greatest commitment to ecological integrity and the highest satisfaction (74%) among visitors, while scenario two had the lowest commitment to ecological integrity and the lowest satisfaction (16%) among visitors. Therefore, as ecological integrity decreased, so did satisfaction among visitors.

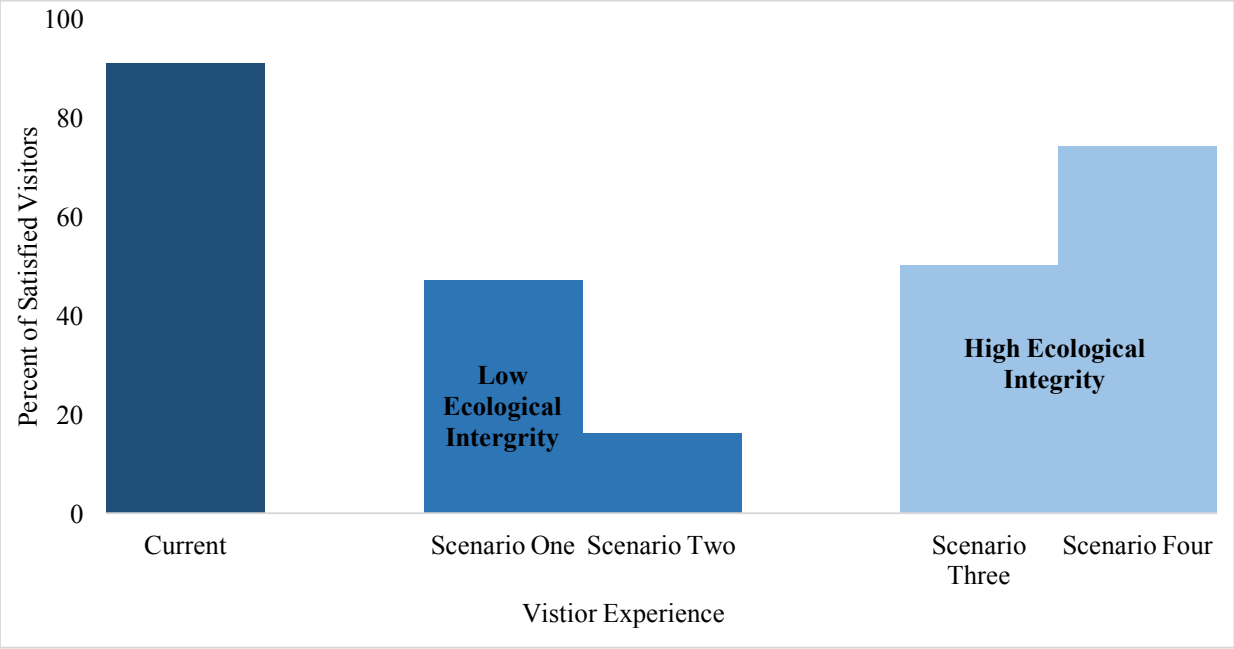

Figure 6: Perception of satisfied or very satisfied visitors with the overall experience.

Note: Satisfaction was measured using a five point likert scale (1 = very unsatisfied; 5 = very satisfied).

Satisfaction with the four environmental conditions also decreased in 2050 when compared to the current experience. For the current and 2050 scenario, visitors were most satisfied with proglacial lakes and streams and least satisfied with vegetation. However, vegetation had the lowest percentage (15%) of change in satisfaction from the current experience to the projected 2050 experience. When comparing the percentage of satisfied or very satisfied visitors with the current experience to the projected 2050 experience, the largest difference occurred in glacier extent, where the percentage of satisfied visitors decreased by 25%.

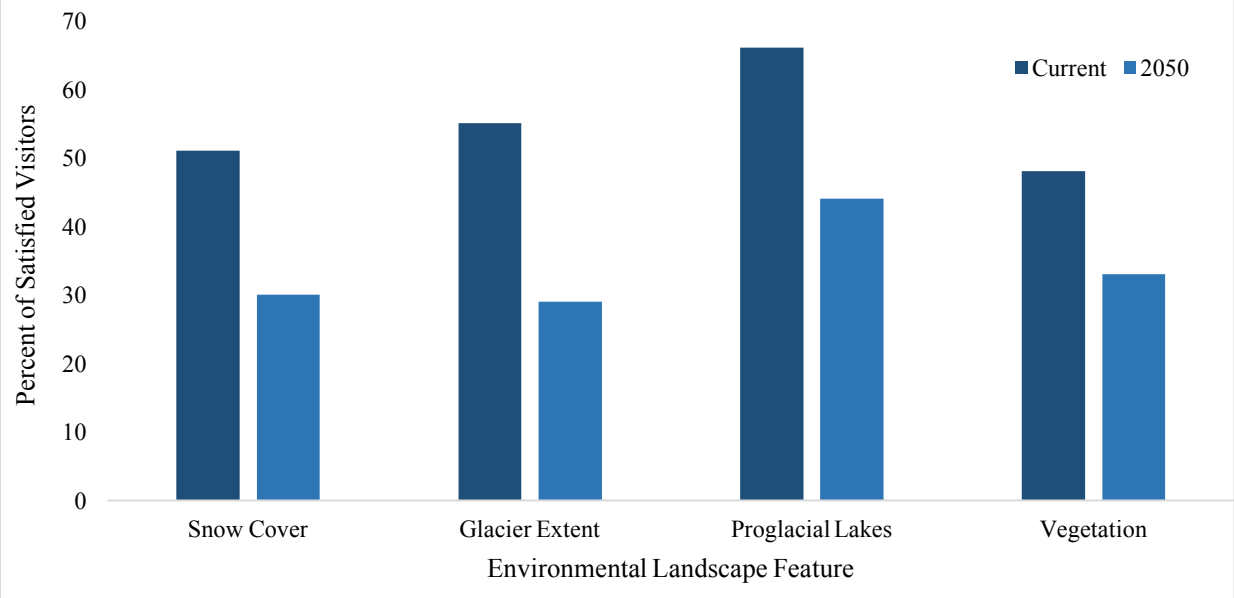

Figure 7: Percent of satisfied or very satisfied visitors with the environmental conditions of the current experience compared to the 2050 scenario.
Note: Satisfaction was measured using a five point likert scale (1 = very unsatisfied; 5 = very satisfied).

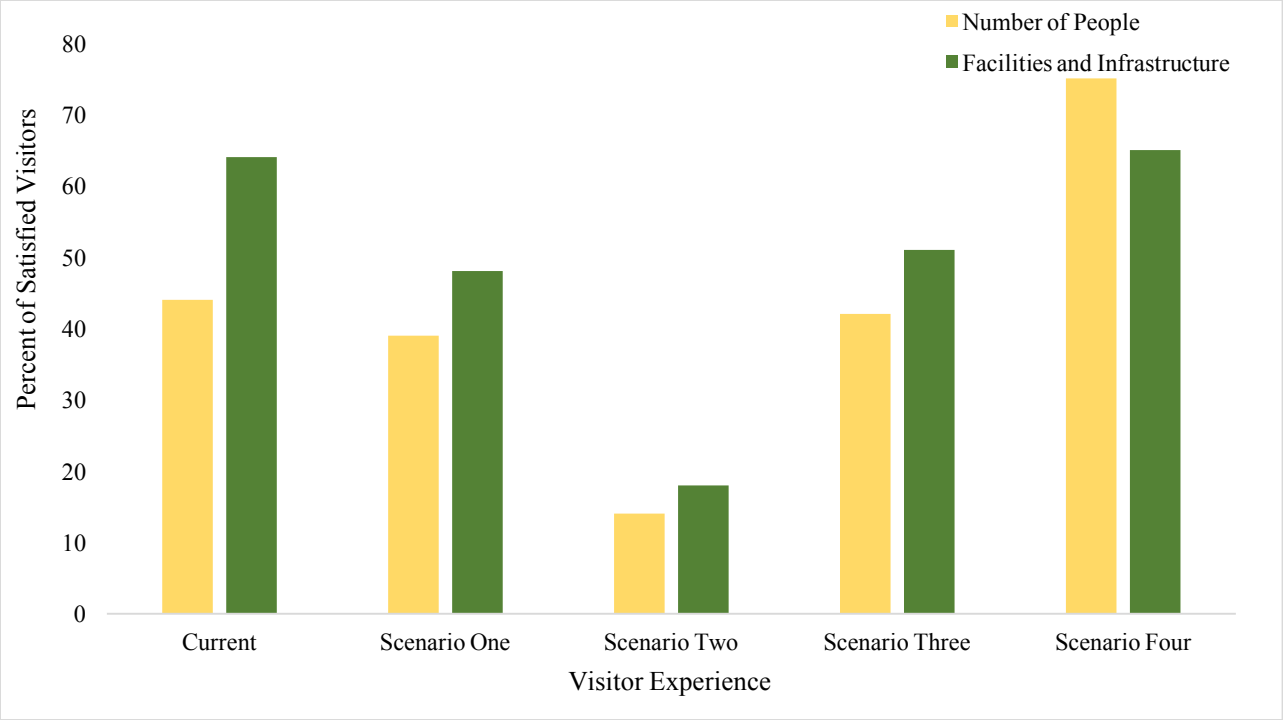

Figure 8: Percent of satisfied or very satisfied visitors with the social and managerial conditions of the current experience compared to the future tourism development scenarios.
Note: Satisfaction was measured using a five point likert scale (1 = very unsatisfied; 5 = very satisfied).

When evaluating visitor satisfaction with the number of people and facilities and infrastructure, satisfaction decreased from the current experience to the future tourism development in all scenarios except for scenario four. Scenario four represented the greatest commitment to ecological integrity and visitor satisfaction with the number of people increased by 31% and 1% for facilities and infrastructure. Scenario two had the lowest commitment to ecological integrity and experienced the largest change in satisfaction. In that scenario, satisfaction with the number of people decreased by 30% and 46% for facilities and infrastructure. Therefore, the vast percentage of visitors were more satisfied with scenario four, which had the least amount of people and fewest facilities and infrastructure of all tourism development scenarios and current conditions.

Chapter 5: Discussion

5.1 Introduction

One of the main goals of parks, recreation and human dimensions' research is to provide input that will ultimately improve decision making (Vaske, 2008). The aim of this research was to determine how much change from the current conditions the Athabasca Glacier could sustain within each of the three components that make up the concept of carrying capacity: environmental resources, the type and quality of the recreation experience, and the extent and direction of management action from the visitor perspective. These three components hold potentially important implications for determining and managing outdoor recreation opportunities in the present and future context. According to Manning (2011) incorporating those three components is a useful way to consider and analyze outdoor recreation in a comprehensive and multidisciplinary way. The following chapter will discuss the results from the perspective of how much change can the Athabasca Glacier sustain and the implications for the overall experience.

5.2 How Much Change can the Athabasca Glacier Sustain?

5.2.1 Environmental Resource: The Athabasca Glacier and Climate Change

The Rocky Mountains are an internationally renowned tourist destination known for its natural environment, scenic landscapes, and diverse wildlife. However, researchers have emphasized that climate-induced environmental change could impact the physical resources and natural environments that destinations, such as the Rocky Mountains, are known for (Lemieux et al., 2010; Scott et al., 2007). This could also affect the quality of the visitor experience and perceived attractiveness of mountain parks (Brownlee et al., 2014; Elasser & Burki, 2002; Scott, 2003; Scott et al., 2007; Sharp et al., 2014; Wall, 1992). Although the impacts of climate change

on tourism to glacial landscapes remains uncertain in many regions (Scott & Suffling, 2000), this research aims to develop a greater understanding of how landscape change at the Athabasca Glacier could affect visitor experience and satisfaction.

To fully understand the implications of climate-induced environmental change, it was important to determine visitors' perceptions of climate change. Visitors at the Athabasca Glacier were aware that climate change is happening and believed that humans are contributing to climate change. The results from this study are consistent with previous research conducted in parks and protected areas. For example, in Churchill, Manitoba 89% of visitors agreed that climate change was happening and 83% were either moderately or extremely concerned about climate change (Groulx et al., 2016a). Similarly, visitors at the Athabasca Glacier (Groulx et al., 2016b) and Franz Josef and Fox Glacier (Wilson et al., 2014) felt that climate change is happening (92% and 93% respectively), 79% (Groulx et al., 2016b) and 81% (Wilson et al., 2014) felt climate change is caused by human activities; and 71% (Groulx et al., 2016b) and 85% (Wilson et al., 2014) were concerned about climate change. Therefore, most visitors to the Athabasca Glacier and other parks or protected areas are aware and understand that climate change is happening and humans are contributing to these changes. This awareness produces a level of concern among visitors, which has the potential to influence their motivations, expectations and experiences in natural areas that are being affected by a changing climate.

The perceived quality of the alpine environment is an important attraction for mountain tourism (Gossling et al., 2012). The satisfaction for all four environmental factors (snow cover, glacier extent, proglacial lakes, and vegetation) decreased in the 2050 scenario. Proglacial lakes and streams had the highest satisfaction among the environmental conditions for the current and future tourism development scenario. It was somewhat surprising that satisfaction decreased as

some researchers have suggested that proglacial lakes could represent attractive elements and potentially compensate for glacial retreat (Haeberli & Hohmann, 2008; Frey et al., 2010; Garavaglia et al., 2012). However, the results suggest that the emergence of proglacial lakes will not serve as a compensating landscape feature at the Athabasca Glacier. Respondents in this study were inherently aware of climate change and likely understood that the development of proglacial lakes and streams at this site would be a result of climate change, which most visitors felt is human-induced. Therefore, it is possible that visitors did not find emerging proglacial lakes and streams satisfying because of the associated cause or because respondents just experienced the glacier in its current form and their expectations have not adapted to future conditions. Additionally, Groulx et al. (2016b) found that visitors at the Athabasca Glacier had a significantly lower preference for the scenario depicting climate impacts and rated the scenario as being significantly less natural. These findings are consistent with similar studies that have examined future landscape preferences of natural areas affected by climate change (e.g. Groulx et al., 2016b; Scott et al., 2007; Stewart et al., 2016; Wilson et al., 2014; Yuan et al., 2006).

Scott et al. (2007) conducted a survey at Waterton Lakes National Park and determined that the mountain landscape is a critical factor in attracting visitors as 75% of respondents indicated this to be either important or extremely important to their decision to visit the park. Consequently, any environmental changes that diminish that landscape could have a negative effect on park tourism. Research conducted in glacial environments worldwide has supported the notion that receding glaciers could become a reason for not visiting parks in the future. For example, Groulx et al. (2016b) found that 22.9% of visitors to the Athabasca Glacier would likely not have made their current trip if they expected to experience conditions reflected in the 2050 scenario (Figure 3). Similarly, Stewart et al. (2016) reported that almost half (46%) of the

visitors at the Fox and Franz Josef Glaciers in New Zealand indicated that they would not have visited the region if they thought they might not be able to see the glaciers. A surveyed collected by Wang et al. (2010) indicated that 80% of tourist's motivations to Yulong Mountain included enjoying and seeing the Baishui Glacier. If glaciers were to disappear in this region, the appeal to tourists would be impaired, the number of tourists would decline and tourism development would be unfavorably influenced (Yuan et al., 2006). Therefore, it is evident that receding glaciers will result in a reduction of glacier tourism resources and diminish the landscape quality, which will ultimately influence visitor experience. This highlights the importance of understanding the behavior of future tourists under changing climatic and environmental conditions to help determine potential visitor trends (Lemieux et al., 2010).

Despite concerns that climate-induced environmental change may adversely impact mountain destinations, Gossling et al. (2012) argues that the scale that changes occur may lessen the impact on visitation to mountain destinations because the frame of reference for mountain landscapes may evolve. However, Gossling et al. (2012) also states that this may not be the case for some high-profile attractions or specialized market segments. It may be possible that the frame of reference may differ among generations of visitors and affect subsequent satisfaction. The results from this study support this as visitors under the age of 40 were more satisfied with the overall current experience than those over the age of 40. Visitors under 40 were also more likely to indicate that they were somewhat or very sure climate change is happening when compared to those over the age of 40. However, the level of concern among those under 40 and over 40 was identical, as well as their indication of the cause of climate change.

There remains some uncertainty whether future visitors will be deterred from visiting landscapes that have experienced climate-induced environmental change if they have never

experienced the landscape attributes that current visitors used to define and measure the quality of the experience (Scott et al., 2007). For example, Scott et al. (2007) suggest that the perception of contemporary visitors may not be shared by future generations. Gossling et al. (2012) also argue that it is possible that tourists may start to perceive climate change impacts relatively if a large proportion of destinations share similar resource attributes, then degraded conditions may become the new norm. Predicting the behavior of future tourists has proven to be a difficult task as it is possible that tourists may learn to accept new conditions, adjust their perception of acceptable conditions or focus on a different set of activities supported by prevailing environmental conditions (Gossling et al., 2012).

Hall (2008) highlighted that the potential acceptance by tourists of environmental change is related to the expectations that have been created in tourism promotional and marketing material. Ramis & Prideaux (2013) emphasize that in the case of the Great Barrier Reef, future tourists are likely to have little to no previous reef experience and as a result, perceptions will be shaped by the media and destination marketing. This implies that future perceptions and expectations can be controlled or monitored through proper marketing that present a realistic representation of what the experience will be like. Furthermore, Garavaglia et al. (2012) suggest it is important to provide tourists with information to help them identify and understand the changing landscapes and help them prepare for the landscape they will potentially see in years ahead. It is important to understand visitor perceptions of the effects of climate change because that information will be imperative in informing the development and implementation of education, interpretation and adaptation strategies associated with tourism (De Urioste-Stone et al., 2015). Understanding the behavior of future tourists is an important conceptual barrier for

climate change impact and adaptation studies in the tourism sector to overcome (Scott et al., 2007).

5.2.2 Type and Quality of the Recreation Experience: The number of people

It is hard to definitively conclude whether the Athabasca Glacier is crowded or not, since less than half (46%) of visitors felt moderately to extremely crowded and only 44% of visitors were dissatisfied with the number of people at the site. Furthermore, Shelby & Herberlein (1986) state that if more than 75% of visitors to a location feel crowded, then the social carrying capacity of a location has been exceeded. At no point during the data collection period on a specific day or time, did 75% of visitors at the Athabasca Glacier feel crowded. In general, crowding did increase over the course of a day and was more prominent during the first data collection period. Crowding likely decreased during the second data collection period because it was nearing the end of summer and the peak season.

The phenomenon of crowding is complex and the relationship between the number of encounters and perceived crowding can be complicated. Needham & Rollins (2009) argue that visitors have invested time, money and energy into their park experience and the last thing they want to admit to themselves or a researcher is that they felt crowded or dissatisfied with their experience. This may explain why most studies fail to establish a substantial or statistically significant relationship between encounters and crowding. It is also possible that those who anticipate crowds are displaced by people who are more tolerant of crowding or avoid visiting the park at crowded times. Visitors may also redefine their experience to avoid feeling disappointed. For many visitors it is their first time, so they have little to no prior expectations for appropriate use levels. Many of these factors may have played a role in establishing crowding at the Athabasca Glacier. It is also conceivable that visitor's evaluation of crowding may have

been influenced by their experience in other parts of the Rocky Mountains. For example, if a visitor travelled to the glacier from the town of Banff or Lake Louise, which are very popular and congested sites, they may not find the Athabasca Glacier site crowded. Whereas, if the Athabasca Glacier was their first stop during their Rocky Mountain vacation, they may find the site crowded. Therefore, the results from this study reveal that the social carrying capacity at the Athabasca Glacier has not been exceeded but the results suggest that any increase in the number of visitors would be considered unacceptable by visitors. However, as the glacial landscape continues to change it is conceivable that fewer visitors could be interested in visiting the site. If this were the case and the site received fewer visitors, they may become increasingly satisfied with the number of people at the site, as they were in scenario four, and this may reduce or eliminate any concern of crowding. The Athabasca Glacier site could see this paradox where satisfaction among the different elements of the experience change as the degradation of the resource becomes more prominent.

Among the tourism development scenarios, visitors had the highest level of satisfaction with the number of people in scenario four because it featured the least amount of people. The correlation matrix for the tourism development scenarios indicated that the number of people were significant in determining visitor's overall satisfaction, which is consistent with results from Whisman & Hollenhorst (1998). They found that river use levels and perception of crowding had an overall negative effect on boater's satisfaction. These results correspond to other crowding studies in recreation and can be explained by the fact that people often visit parks to get away from urban environments that are known for congestion and over population to experience nature without interference of others in the same setting (Needham et al., 2016b). They also suggest that crowding is associated or a result of the number of encounters a person

experiences or anticipates experiencing. A similar study using simulated photographs to show the number of people at a site found that respondents encountering lower numbers of people felt less crowded and considered these use levels to be more acceptable, and consequently perceived the area as more pristine and less developed (Kim et al., 2014). Examining use levels, crowding and perceptions of a setting is important for protecting resource values, visitor experience and guiding recreation management (Kim et al., 2014; Manning, 2011).

5.2.3 Direction of Management Action: Facilities and Infrastructure

Over time more emphasis has been placed on maintaining parks for future generations in an unimpaired state and ensuring that visitors have an experience founded on appreciate of landscape and nature (Needham et al., 2016a). Historically, visitation and ecological integrity were considered mutually exclusive and to protect ecological integrity, visitation had to be regulated or restricted (Needham et al., 2016a). It is now recognized that parks and protected areas are part of larger landscapes, and visitation can be used for enhancing rather than detracting from the environmental quality if it is managed appropriately (Needham et al., 2016a). For instance, parks provide the ideal environment for encouraging personal changes in everyday life (Needham et al., 2016a). It is becoming widely recognized that the long-term viability of protected areas and the conservation agenda is contingent on educating the next generation (Needham et al., 2016a). Parks and protected area managers have long used interpretation as a tool for increasing knowledge and managing tourist behaviors toward important resources (Powell et al., 2008). When a visitor experience is translated into pro-environmental behaviors or they become environmental ambassadors, the experience can be seen as enhancing rather than detracting from the environmental quality. However, this does not always translate as protected managers hope. A survey of Antarctic visitors found that environmental behavioral intentions

increased significantly immediately after participation but three months later, the results indicate that participants only incrementally changed their environmental behaviors (Powell et al., 2008).

Park managers are often tasked with balancing ecological integrity and visitor experience. Eagles & McCool (2002) suggest that the tension between tourism development and protection of cultural and natural values will always remain. Park managers often focus on two major questions: what can be done to enhance the quality of a visitors' experience and how can the impacts of visitors be managed to acceptable levels and for desirable outcomes (Eagles & McCool, 2002). Ecological integrity is an important underlying principle in designing and managing protected areas as it embodies functional ecological conditions and processes that are essential for the maintenance of species, biotic communities and other natural features (Lemieux et al., 2010). Most facilities in parks and protected areas were designed to fulfil basic functions and enhance the site's ability to provide recreation opportunities (Eagles & McCool, 2002). However, Lemieux et al. (2010) suggest that parks and protected areas management should focus on maintaining and where possible enhancing ecological integrity, complexity and resilience.

Furthermore, the development of recreation facilities and infrastructure changes the landscape and ecological systems of the area, which occasionally has negative or unpredictable consequences (Kim et al., 2014). Providing visitors with high quality experiences is a major management goal in parks and protected areas. Development is favored because it can facilitate use, offer greater convenience, provide a more hardened site that can withstand use, or bring economic benefits from increased visitation (Manning, 2011). However, Manning et al. (2004) argue that natural areas should remain more primitive from an ethical perspective. Similarly, Loomis & Walsh (1997) suggest that the economic benefits may not justify the cost associated with expanding infrastructure or increased management needed for accommodating greater use.

Ultimately, Eagles & McCool (2002) advise that all facilities should be guided by the overall values underlying the park and in Canada national parks are supposed to be guided by the principle that maintains that ecological integrity is the first priority.

Facilities and infrastructure were the most significant factor that influenced overall satisfaction among visitors. The results support the notion that visitors would like to see continued use at the site with a strong desire to learn about what is happening to the glacier and the region more generally. The majority of visitors accepted proposed management actions that involved the development of an educational program or educational material, whereas the least accepted management actions involved limitations to the site. The most acceptable action was the development of an interpretive trail with educational programming, which is somewhat lacking at the site currently. The future tourism development scenarios presented a spectrum of various facilities and infrastructure, such as the existing IceWalk and snocoach tours, proposed canoeing and kayaking on the emerging proglacial lake, helicopter tours, a tram, educational material and guided hikes and interpreters. Satisfaction with each tourism development scenario decreased as the number of facilities and infrastructure increased and commitment to ecological integrity decreased. Previous research done at the Athabasca Glacier by Groulx et al. (2016b) found that snocoach and helicopter tours were rated on average as being unacceptable by visitors. Similarly, Kim et al. (2014) found that the proposed development of a tramway in Mudeungsan Provincial Park in South Korea would result in respondents to consider the area more developed and less natural.

The results suggest that satisfaction will decrease as commercial activities are developed or introduced but these attractions are usually very popular. For example, Groulx et al. (2016b) found that visitors rated snocoach tours as being unacceptable yet Luckman & Kavanagh (2006)

indicated that over 600,000 visitors travel onto the glacier per year on a snocoach. It is important to note that Groulx et al. (2016b) sample was mainly active tourists who may have a distinct set of expectations and/or values than those of snocoach users. Perhaps visitors know or understand what a natural environment should consist of and therefore associate any interference with that as negative. It is also possible that visitors acknowledge that existing snocoach tours are unacceptable but because they are already happening there is no harm in partaking in such an activity. They may also see it as a necessity as it is the only way to actually step foot onto the glacier other than participating in an IceWalk tour. Further research is needed to develop a deeper understanding of this apparent contrast and the acceptability and motivation behind participating in such activities.

Climate change may complicate the existing tension between preservation of the natural environment, commitment to ecological integrity and visitor experience as destinations with diminishing assets try to encourage continued use and economic development. Stewart et al. (2016) acknowledge that receding glaciers in New Zealand have the potential to diminish visitor experience but also have the potential to impact elements of the conservation policy in the national park. The rapidly changing physical conditions at the Fox and Franz Josef Glaciers have presented challenges to tourism operators. These challenges led to an amendment in policy, which saw an increase in the number of possible aircraft landings on the glacier and permission for heavy earthmoving machinery in the riverbed (Stewart et al., 2016). There has already been a change in concession allowances at the Franz Josef Glacier, which permits more aircraft activity and has resulted in significant issues with respect to visitor satisfaction as visitors are annoyed with over-flights in the glacier valley (Stewart et al., 2016). As the tourism resources diminish and result in fewer visitors, political pressure may increase among local communities and

tourism stakeholders to seek benefit from the natural resources in ways less consistent with current conservation goals (Stewart et al., 2016). While the negative effects of tourism are of significant concern for these regions, promoting tourism development is necessary to improve or maintain revenue that helps support conservation efforts (Salerno, 2013).

Jasper National Park has been at the forefront of increased pressure for commercial development and has had its share of controversy with the development of the Glacier Skywalk near the Athabasca Glacier and proposed accommodations at Maligne Lake. Brewster Travel Canada has been operating vehicle-based glacier tours (snocoach tours) for many years and in an effort to expand or perhaps adapt to environmental change at the glacier, the company built a glass-floored observation platform that cost more than $21 million (Needham et al., 2016a). The project saw a public view point being converted into a commercial entity that many argued did not align with Parks Canada's mandate. The main concerns over the development of the Glacier Skywalk included: increased privatization in national parks, ecological impacts, proliferation of "theme park like" developments, inconsistency with Parks Canada policies that limit commercial development in parks and the potential for signaling opportunities to others for further commercial development that could set a precedent and result in cumulative impacts that threaten ecological integrity (Needham et al., 2016a). Groulx et al. (2016b) also suggest that mechanized and/or large-scale visitation infrastructure do not align with the National Parks Act's to make ecological integrity the main priority. The controversy symbolizes the ongoing tension between conservation and visitor use in Canada's national parks (Needham et al., 2016a). However, it is important to acknowledge that Jasper is a large national park with high visitation numbers and a lot of assets (highways, campgrounds, day-use areas, washrooms, trails and other facilities). Commercial operations that generate a lot of revenue are crucial to the park as money

can be invested into maintaining assets and funding conservation initiatives. Unfortunately, these commercial endeavors may not align with Parks Canada's mandate or other parks and protected areas mandate but with budgetary constraints and increasing demands, they can be seen as a necessity or viable options for park managers.

Adaptation at tourism destinations will be required to minimize risks or to capitalize on new opportunities associated with climate-induced change (Scott et al., 2012a). The diversification of tourism products has been acknowledged as a possible adaptation mechanism that is a particularly effective strategy that can limit sensitivity to economic and other crises (Dubois & Ceron, 2006). However, the very long timeframes of climate change impacts are considered largely incompatible with business planning, which often makes it a low business management priority (Scott et al., 2012a; Scott et al., 2012b). For example, at the Athabasca Glacier the projected environmental change and tourism development scenarios were representative of 2050. There is approximately 30 years between the current reality and the projected glacial landscape at this site. Businesses and stakeholders may be inherently aware of what the future holds but because the changes are occurring at a slower pace, it may not be a business priority yet. Although it could be argued that Brewster has already begun preparing for that possible future, as they began expanding in light of the unknown. It is also unclear how much longer the snocoach tours are going to be a safe operation. Since precedent has been set in this park, it is conceivable that scenario one or two could become a reality, perhaps not at the scale suggested but the development of any of the infrastructure features is within the realm of possibility. For example, helicopter tours have become a significant part of the tourism experience in New Zealand. In light of climate change, there are endless possibilities on how sites can be managed and managers are faced with the decision of preserving the site and keeping

it as natural as possible or generating as much revenue out of the site before it diminishes completely. Managers may wonder that since commercial activities already exist at the glacier site and nearby, is it even conceivable to maintain a natural site?

While the changing conditions are creating some challenges for balancing conservation policy against commercialization, the receding glaciers present an opportunity for educating the visiting public about the realities of climate change (Stewart et al., 2016). Glaciers are one of the world's most prominent physical examples of climate change and provide an enormous opportunity to educate tourists on the impacts of climate change and encourage lifestyle changes that reduce impacts. Development and exploitation of the resource is not the only way to enhance visitor experience at these sites. In Norway, three glacier visitor centers were developed around the Jostedalen Glacier that focus on educating visitors about climate change (Aall & Hoyer, 2005). They are using the link between climate change and changes in the glacier as a window of opportunity to raise awareness about climate change (Aall & Hoyer, 2005). Stewart et al. (2016) suggest that broader conservation outcomes may be realized through interpretation of glacier recession scenarios, allowing tourists to see and understand the effects of a changing climate at a local scale (Stewart et al., 2016). Similarly, Groulx et al. (2016b) recommend interactive art installations on site as they could present plausible climate futurescapes in a compelling and emotional manner. Images of the glacier though the decades could help visitors understand the changes that are occurring at the glacier. Interpretation can also promote public understanding of an agency's goals and objectives (Hvenegaard & Shultis, 2016) and programs have a positive influence on visitor satisfaction (Ham & Weiler, 2007; Hill et al., 2007). However, interpretive programs have a history of being negatively influenced by budget cuts and reductions in revenue (Hvenegaard & Shultis, 2016). Nonetheless, parks and protected areas represent important

vehicles to inform and educate the public on climate change and the various tools available to mitigate the causes and impacts of climate change (Lemieux et al., 2010).

5.3 Implications for Overall Visitor Experience

Groulx et al. (2016b) found that visitors at the Athabasca Glacier have a strong desire for a natural experience, which is consistent with the results from this study. The overall satisfaction among the tourism development scenarios decreased as the commitment to ecological integrity and naturalness of the environment decreased. This suggests that visitors are inherently aware of the type of environment they are in and have a strong perception of what a natural environment should look like. Schweizer et al. (2013) found that over half (55%) of visitors were either strongly attached or attached to the park they were visiting. Although many of the respondents are often first-time visitors, the attachment is likely due to the iconic, awe inspiring nature of the national park or landscape (Schweizer et al., 2013). This attachment and desire to visit parks and protected areas may be in jeopardy because of climate-induced environmental change.

From the results, it is apparent that the relationship between overall satisfaction with the current experience and the future tourism development scenarios is complex. Overall satisfaction among all future tourism development scenarios is lower than that of the current experience, which may be further explained by the factors (environmental, social and managerial) that influence visitor experience. However, what is clear is that scenarios where ecological integrity was not prioritized experienced a significant decrease in satisfaction.

Figure 8 illustrates the number of satisfied visitors with the overall experience for each tourism development scenario in comparison to the likelihood of them still visiting if the conditions were similar to those depicted in each scenario. There appears to be some discrepancy between satisfaction with the tourism development scenarios and the desire to still visit the

destination under that same scenario. Visitors were decisive in determining their satisfaction and likelihood for still visiting in scenario two, which depicted the lowest commitment to ecological integrity and highest number of visitors. On the other hand, visitors appeared to be conflicted with scenario four, which presented the highest commitment to ecological integrity and lowest number of visitors. Although it received the highest satisfaction and highest likelihood to still visit among the tourism development scenarios, the variance between those satisfied and those who would still visit is substantial. As mentioned before, this could be a result of visitors understanding what a natural environment should be like but at the same time desiring a more engaging or opportunistic visitor experience. Perhaps visitors are conflicted between what they feel the site should look like versus what they desire for their vacation. Despite the fact that scenario four represents the most natural landscape, it may be the case that visitors are reluctant to visit the destination due to climate-included environmental change. These findings are consistent with Vaske (2008) who stated that the relationship between satisfaction and participation is not as direct as one might expect. For example, a person can find an experience dissatisfying but continue to participate and vice versa. It is important to not just measure individual or overall satisfaction but to determine the relative importance of different facets of satisfaction and the other factors that motivate behavior (Vaske, 2008).

The likelihood of tourists still visiting the site was also influenced by the country of origin. Domestic tourists indicated that they were more likely to still visit the site compared to international tourists. Those who reside in Alberta and British Columbia were more likely to still visit the site, alongside Americans and Australians. The variance in likelihood to still visit the site between domestic and international visitors may be explained by the proximity to the Rocky Mountains and other alpine landscapes. For example, Americans are in close proximity to the

Rocky Mountains and benefit from a low Canadian dollar, whereas Europeans may be inclined to visit alpine environments, such as the Alps, instead of the Rocky Mountains. Climate-induced environmental change could alter the demographics of visitors and international travel to the Athabasca Glacier, whereby there could be a decrease in international tourists and an increase in domestic tourists or vice versa. Future visitation is one of the many uncertainties that is associated with subsequent climate-induced environmental change.

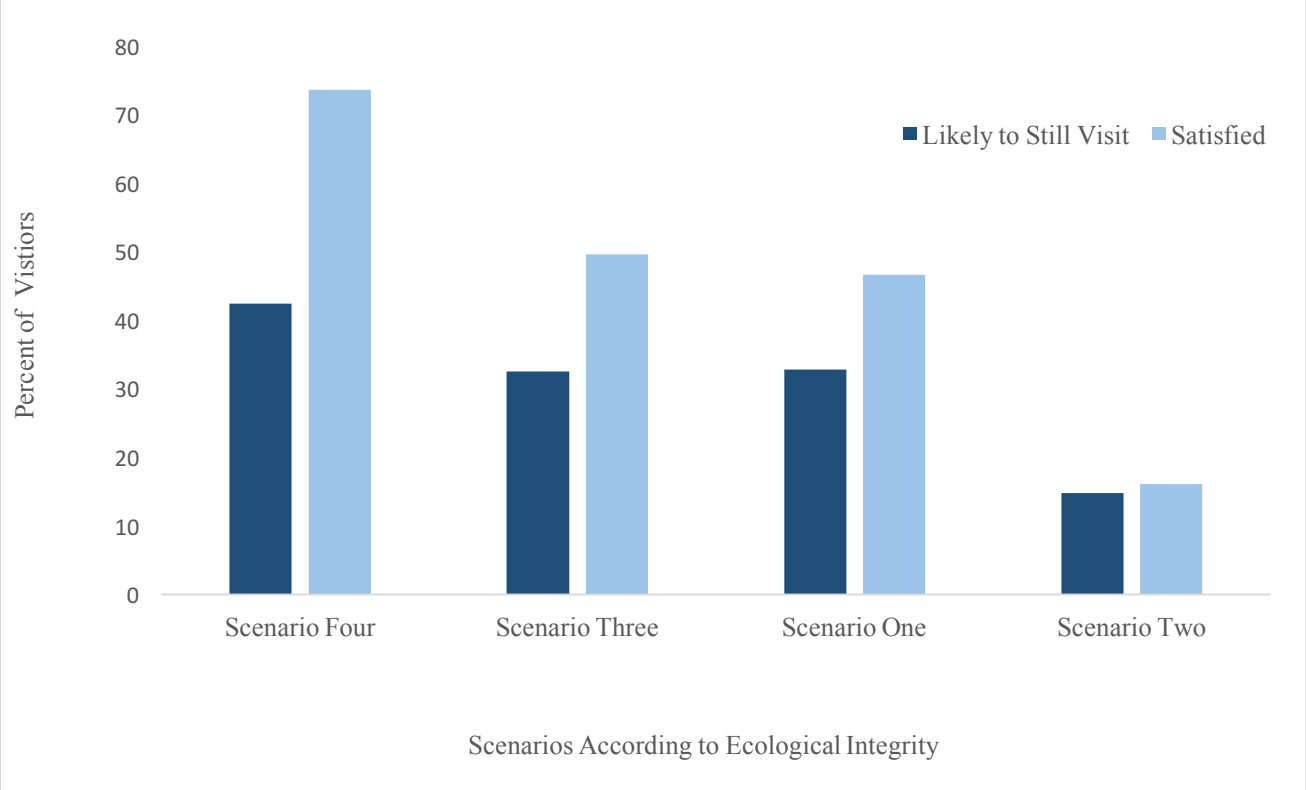

Figure 9: Number of satisfied or very satisfied visitors and number of visitors who would have still visited under the conditions depicted in the scenarios.

Chapter 6: Conclusion

6.1 Future Research

The results from this study contribute to the work that has been done by Groulx et al. (2016b) at the Athabasca Glacier but there remains a tremendous opportunity for continued research at this site. There were several questions that emerged from the findings of this research, such as: would visitors be satisfied with emerging environmental conditions if they were unaware of its cause? Are they dissatisfied because of the negative connotation associated with climate change or because there is change in a natural area? Would visitors who have never been to the Athabasca Glacier be dissatisfied with the 2050 scenario?

These emerging questions could be answered and valuable insight could be gained from utilizing other methods, such as qualitative interviews. Interviewing visitors at the Athabasca Glacier may reveal a more in-depth understanding of their motivations, expectations, perceptions and experiences. They could also provide a more detailed understanding of the role that glacial landscapes play in attracting visitors to the Rocky Mountains. It would be interesting to discuss the acceptability of various components of the scenarios with visitors in more detail than a quantitative survey would allow. However, this would likely be a large undertaking and somewhat challenging as visitors are reluctant to even participate in a short survey because they are in a rush.

To overcome the potential response bias, future research could explore the opinions between current visitors and those who have never visited the site, as well as the opinions of those who only visited the Columbia Icefield Centre. Additionally, this research was solely from the visitor perceptive, therefore it would be valuable to explore the opinions and perspective of other actors, such as tourism stakeholders and local community members. The methods and

approach used for this study are not limited to the Athabasca Glacier and can be easily repeated in other parks or protected areas that are experiencing climate-induced environmental change. Thereby expanding the knowledge and understanding of how climate-induced environmental change could affect visitor satisfaction and behavior of future tourists.

6.2 Recommendations for Parks Canada

It is important for park managers to consider how visitors will respond to proposed developments and increasing use levels ahead of time because developments can be extremely difficult to remove or restore (Kim et al., 2014). One of the main conclusions from this study is that climate-induced environmental change will impact visitor experience and satisfaction at the Athabasca Glacier. Although environmental change will negatively affect satisfaction it is evident that satisfaction could be further impacted by potential management decisions.

Consequently, the findings indicate that visitors are not driven by commercialization and are seeking an experienced that limits further impact. Visitors are also interested in an experience that allows them to learn, as half of the sampled visitors indicated that learning about glaciers and the impacts of climate change on glaciers were important in their decision to visit the site. This supports the research done by Schweizer et al. (2013) that revealed visitors are willing and eager to learn about climate change in protected areas. Therefore, rather than focusing on commercial development, an expanded interpretation program should be developed to provide visitors with information about climate change and glaciers. For example, a self-guided interpretive trail with visual images of the glacier over time and written material about the glacier, how it has changed, why it is changing and the role of humans and climate change, could enhance visitor experience in a positive way. Parks Canada and park managers at Jasper national park have a tremendous opportunity to use one of Canada's most iconic landscapes as an

educational tool to help visitors understand their impact and the importance of environmental protection and conservation.

6.3 Final Thoughts

Park managers are faced with the dilemma of balancing ecological integrity and visitor experience, which can be challenging when hosting two million visitors annually as Jasper National Park does. This dilemma will be further complicated by climate change as it continues to alter the landscape at the Athabasca Glacier and create new challenges and opportunities for park managers. In an attempt to understand how much change the Athabasca Glacier can sustain from its current condition, it is clear that climate-induced environmental change will affect visitor experience and satisfaction. Satisfaction was informed by a concern for climate change and visitors were more sensitive to development than just environmental landscape changes. The results reinforce the meaningful relationship that exists between ecological integrity, aesthetic quality and consumer behavior at this site (Groulx et al. 2016b).

These findings hold important insight into the current visitor experience and the future visitor experience at the Athabasca Glacier. From a theoretical standpoint, the results support the emerging phenomenon of scenario planning and visualizations as a method for evaluating and understanding perceptions of change. From a practical standpoint, these results provide Parks Canada with a better understanding of visitor experience at the Athabasca Glacier and the acceptability of potential management actions and development scenarios. It is clear from this research that scenarios where ecological integrity was prioritized experienced less drastic changes in overall satisfaction. Determining the point at which change becomes unacceptable requires some element of management judgement (Manning & Lawson, 2002) and the results from this study provide Parks Canada with the groundwork. Furthermore, this study can be used

to better inform policy and management decisions at a park level and help identify what needs to be done to protect Canada's significant nature-based tourism industry in Western Canada.

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Appendix A: Survey Instrument

The Future of Tourism at the Athabasca Glacier

Dear Visitor,

The following research is being conducted by a graduate student from the Department of Geography and Environmental Management at the University of Waterloo. Participation in this study will help in our efforts to improve our understanding of visitor experience and tourist expectations at the Athabasca Glacier.

This research and recommended management actions in the survey are being conducted and proposed solely by the University of Waterloo and is not associated in any way with the Parks Canada Agency.

The survey is expected to take about 10-15 minutes and can be completed using the tablet provided. You may omit any question you prefer not to answer by leaving it blank and you may withdraw your participation by not submitting your responses.

Participation in this survey is voluntary and anonymous. You are not asked for your name or any identifying information. All information you provide will be considered confidential and responses to the survey questions will be summarized with the responses of other visitors. There are no known or anticipated risks to participation in this study.

This study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. If you have any questions or would like additional information about the study to assist you in reaching a decision about participation, you may contact, Dr. Daniel Scott at daniel.scott@uwaterloo.ca. If you have any comments or concerns about your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

Your opinions are very much appreciated and needed for this project. If you wish to participate in this survey, please begin.

Part A: About your Visit

A1. Prior to your visit, how many times have you been to the Athabasca Glacier?

☐ 0 ☐ 1 – 2
☐ 3 – 4 ☐ 5 or more

A2. How much time will you spend in Jasper National Park?

☐ Less than a full day
☐ A full day but I will not stay overnight
☐ More than one night

☐ Not sure

A3. Will you be visiting other national or province parks during your trip (e.g. Banff, Yoho)?

☐ Yes ☐ No ☐ Not sure

A4. How else will you be viewing the glacier? (select all that apply)

☐ Wilcox pass
☐ Columbia Icefield Visitor Centre
☐ Glacier IceWalk
☐ Glacier Skywalk (Brewster)
☐ Glacier Adventure Tour (Brewster)

Part B: Motivation for Visiting

B1. How important were the following in influencing your decision to visit Jasper National Park?

	Extremely Important	Very Important	Moderately Important	Slightly Important	Not at all Important
To develop personal, spiritual values	☐	☐	☐	☐	☐
To feel connected to an environment that may not exist in the future	☐	☐	☐	☐	☐
To reflect on how humans are impacting the environment	☐	☐	☐	☐	☐
To experience a sense of discovery	☐	☐	☐	☐	☐
To learn about glaciers	☐	☐	☐	☐	☐
To share what I have experienced with others	☐	☐	☐	☐	☐
To learn about the impacts of climate change on glaciers	☐	☐	☐	☐	☐
To have a story to tell	☐	☐	☐	☐	☐
To experience places I have read about	☐	☐	☐	☐	☐
To feel like I was the one of the last people to view the glaciers here	☐	☐	☐	☐	☐
To be able to view an easily accessible glacier	☐	☐	☐	☐	☐

Part C: Current Experience & Satisfaction

C1. Please indicate your agreement with the following statements regarding your expectations of your visit to the glacier:

	Agree Strongly	Agree	Unsure	Disagree	Disagree Strongly
I expected there to be more people at the glacier view point	☐	☐	☐	☐	☐
I expected there to be more facilities at the glacier (e.g. recreational activities to facilitate glacier viewing experiences, washrooms etc.)	☐	☐	☐	☐	☐
I expected there to be more educational materials (e.g. more visible, informative, accessible)	☐	☐	☐	☐	☐

C2. Approximately how many visitors you encountered during your visit to the glacier? (Please circle one number).

<10 11-30 31-50 51-70 71-90 >90

C3. Please indicate the extent of crowding you experienced during you trip at the glacier. (Please circle one number).

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded			Moderately Crowded		Extremely Crowded	

C4. Please indicate your satisfaction with the following:

	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied
Snow cover	☐	☐	☐	☐	☐
Glacier extent	☐	☐	☐	☐	☐
Proglacial lakes and streams	☐	☐	☐	☐	☐
Vegetation	☐	☐	☐	☐	☐
The number of people at the site	☐	☐	☐	☐	☐
Facilities and infrastructure provided to facilitate glacier viewing experiences	☐	☐	☐	☐	☐
Overall experience at the glacier site	☐	☐	☐	☐	☐

Part D: The Athabasca Glacier in 2050

This section will explore the expectations of tourists to Jasper National Park in the years ahead, as the Athabasca Glacier continues to change. For many of the tourists, experiences will change

and expectations will be challenged as some features are lost and new characteristics appear. After a short description of how the glacier is anticipated to change over the next 40 years, you will be presented with a series of scenarios for tourism development in 2050. Please respond to the following questions regarding potential tourism development scenarios for the glacier site in 2050.

Environmental Change

Half of the glacier's volume and 1.5 km of its length has already been lost, and by 2050 further recession will have occurred. It is projected that the rate of loss between 2014 and 2050 will be 0.06 km per year (60 m). One result of retreat that has been occurring rapidly at glaciers worldwide is the formation of lakes and streams. Terrain is changing each year and as the glacier thins and retreats, moraine walls, thicker debris cover, growth of new vegetation, complex elevation changes and more challenging topography will develop. The following image depicts possible changes for the future of the glacier.

D1. Please indicate your satisfaction with the following landscape features based on the image you viewed.

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
Snow cover	☐	☐	☐	☐	☐
Glacier extent	☐	☐	☐	☐	☐

Proglacial lakes and streams	☐	☐	☐	☐	☐
Vegetation	☐	☐	☐	☐	☐

Scenario 1

D2. Please indicate your satisfaction with the following features based on the image you viewed.

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
The number of people	☐	☐	☐	☐	☐
Facilities and infrastructure provided to facilitate glacier viewing experiences	☐	☐	☐	☐	☐
Overall visitor experience at the glacier site	☐	☐	☐	☐	☐

D3. What is the likelihood that you would have still visited the Athabasca glacier if the conditions were similar to those depicted in the image?

☐ Extremely likely
☐ Likely
☐ Somewhat likely
☐ Unlikely

☐ Extremely unlikely

Scenario 2

D4. Please indicate your satisfaction with the following features based on the image you viewed.

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
The number of people	☐	☐	☐	☐	☐
Facilities and infrastructure provided to facilitate glacier viewing experiences	☐	☐	☐	☐	☐
Overall visitor experience at the glacier site	☐	☐	☐	☐	☐

D5. What is the likelihood that you would have still visited the Athabasca glacier if the conditions were similar to those depicted in the image?

☐ Extremely likely
☐ Likely
☐ Somewhat likely
☐ Unlikely
☐ Extremely unlikely

Scenario 3

D6. Please indicate your satisfaction with the following features based on the image you viewed.

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
The number of people	☐	☐	☐	☐	☐
Facilities and infrastructure provided to facilitate glacier viewing experiences	☐	☐	☐	☐	☐
Overall visitor experience at the glacier site	☐	☐	☐	☐	☐

D7. What is the likelihood that you would have still visited the Athabasca glacier if the conditions were similar to those depicted in the image?

☐ Extremely likely
☐ Likely
☐ Somewhat likely
☐ Unlikely
☐ Extremely unlikely

Scenario 4

D8. Please indicate your satisfaction with the following features based on the image you viewed.

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
The number of people	☐	☐	☐	☐	☐
Facilities and infrastructure provided to facilitate glacier viewing experiences	☐	☐	☐	☐	☐
Overall visitor experience at the glacier site	☐	☐	☐	☐	☐

D9. What is the likelihood that you would have still visited the Athabasca glacier if the conditions were similar to those depicted in the image?

☐ Extremely likely
☐ Likely
☐ Somewhat likely
☐ Unlikely
☐ Extremely unlikely

Overall Evaluation

D13. Please rank the following scenarios from 1 (most appealing) to 5 (least appealing).

☐ Current Conditions ☐ Scenario 1
☐ Scenario 2 ☐ Scenario 3
☐ Scenario 4

Part E: Management Action

E1. Please indicate the acceptability of the following management actions that could be implemented in Jasper National Park, based on the **current** conditions that you experience during your visit to the Athabasca Glacier.

	Very acceptable	Acceptable	Neutral	Unacceptable	Very unacceptable
Limit access to the glacier (e.g. the number of users that can enter the glacier site)	☐	☐	☐	☐	☐
Development of another site for glacier visitation (e.g. Angle Glacier on Mt. Edith Cavell)	☐	☐	☐	☐	☐
Development of a certified park guided interpretive trail with educational programming on climate change (e.g. using signs to help guide visitors to interesting features that might otherwise be overlooked or not fully appreciated)	☐	☐	☐	☐	☐
Limit access to the site by privatized group tours with certified guides	☐	☐	☐	☐	☐
Permanently close the site from all visitation	☐	☐	☐	☐	☐
Provide a transportation system to provide more sustainable access to the glacier(e.g. shuttle bus from the town of Jasper or Banff)	☐	☐	☐	☐	☐

Implement citizen science program to engage the public in climate change issues and help collect data (e.g. establish a website that provides information and data on various environmental changes occurring at the glacier)	☐	☐	☐	☐	☐

Part F: Climate Change

F1. Do you think climate change is happening?

- ☐ Very sure it is not happening
- ☐ Somewhat sure it is not happening
- ☐ Unsure
- ☐ Somewhat sure it is happening
- ☐ Very sure it is happening

F2. Do you think climate change is?

- ☐ Caused mostly by human activities
- ☐ Caused mostly by natural changes in the environment
- ☐ Caused by human and natural changes
- ☐ None of the above because climate change is not happening

F3. How concerned are you about the climate change issue?

- ☐ Not at all concerned
- ☐ Somewhat concerned
- ☐ Moderately concerned
- ☐ Extremely concerned

Part G: About You

G1. In what year were you born?

G2. Please indicate your gender

☐ Male ☐ Female ☐ Other

G3. Are you a Canadian Citizen?

☐ Yes ☐ No

If yes,

☐ Canadian citizen by birth
☐ Canadian citizen, less than five years
☐ Canadian citizen, more than five years

G4. What is the highest level of education you have attended?

☐ No certificate, diploma or degree
☐ Secondary (high) school diploma or certificate
☐ Registered apprenticeship or trades certificate or diploma
☐ College, CEGEP or other non-university certificate or diploma
☐ University certificate or diploma below the bachelor level
☐ University certificate or diploma or degree at bachelor's level (including LL.B.)
☐ University certificate or diploma or degree above bachelor's level (e.g. Master's or PhD)

G5. What is your annual household income?

☐ Less than $20,000
☐ $20,000 – $39,000
☐ $40,000 – $59,000
☐ $60,000 – $79,000
☐ $80,000 - $99, 000
☐ $100,000 or more
☐ Prefer not to answer

G6. Please indicate your postal (or zip) code:

This is the end of the survey. Thank you for your participation!

Appendix B: Supplementary Booklet of the Future of Tourism at the Athabasca Glacier

The Future of Tourism at the Athabasca Glacier

Potential Futures for Tourism Development in 2050

Existing Conditions

Environmental Change

Scenario 1

Scenario 2

Scenario 3

Scenario 4

Appendix C: Spearman Correlation Matrix for the Current and Future Tourism Development Experiences

Table 11: Spearman correlation matrix for the current visitor experience.

	1	2	3	4	5	6	7	8	9	10	11
Motivations											
1. Learning		.345**	.000	-.026	.132*	-.009	.084	.123*	-.011	.103	.206**
2. Sharing			.022	.030	.118*	.137*	.172**	.030	.036	-.094	.145*
Expectations											
3. Number of people				.197**	.092	.018	.019	.049	.244**	.038	.035
4. Facilities and infrastructure					.017	-.005	-.065	-.079	.026	-.385**	-.193**
Satisfaction											
5. Snow cover						.638**	.461**	.383**	.251**	.166**	.372**
6. Glacier extent							.519**	.394**	.239**	.126*	.340**
7. Proglacial lakes and streams								.572**	.265**	.223**	.325**
8. Vegetation									.290**	.262**	.266**
9. Number of people										.334**	.252**
10. Facilities and infrastructure											.394**
11. Overall experience											

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 12: Spearman correlation for scenario one.

	1	2	3	4	5	6	7	8	9	10	11
Motivations											
1. Learning		.345**	.000	-.026	-.005	-.005	-.063	.019	-.122*	-.049	-.066
2. Sharing			.022	.003	.015	.025	.001	.025	-.023	-.002	-.033
Expectations											
3. Number of people				.197**	.059	.051	-.032	.001	-.023	-.003	.028
4. Facilities and infrastructure					.032	.006	-.045	-.028	.104	.022	.066
Satisfaction											
5. Snow cover						.885**	.637**	.580**	.096	.045	.190**
6. Glacier extent							.655**	.551**	.097	.041	.195**
7. Proglacial lakes and streams								650**	.108	.144*	.185**
8. Vegetation									.076	.117*	.133*
9. Number of people										.581**	.620**
10. Facilities and infrastructure											.695**
11. Overall experience											

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 13: Spearman correlation for scenario two.

	1	2	3	4	5	6	7	8	9	10	11
Motivations											
1. Learning		.345**	.000	-.026	-.050	-.050	-.063	.019	-.153**	-.170**	-.138*
2. Sharing			.022	.030	.015	.025	.001	.025	.009	-.090	-.073
Expectations											
3. Number of people				.197**	.059	.051	-.032	.001	-.063	.005	.004
4. Facilities and infrastructure					.032	.006	-.045	-.028	.123*	.148**	.123*
Satisfaction											
5. Snow cover						.885**	.637**	.580**	.147*	.139*	.167**
6. Glacier extent							.655**	.551**	.127*	.103	.164**
7. Proglacial lakes and streams								.650**	.105	.162**	.156**
8. Vegetation									.100	.141*	.134*
9. Number of people										.694**	.700**
10. Facilities and infrastructure											.810**
11. Overall experience											

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 14: Spearman correlation for scenario three.

	1	2	3	4	5	6	7	8	9	10	11
Motivations											
1. Learning		.345**	.000	-.026	-.050	-.050	-.063	.019	-.134*	-.114*	-.083
2. Sharing			.022	.030	.015	.025	.001	.025	-.039	-.037	-.013
Expectations											
3. Number of people				.197**	.059	.051	-.032	.001	-.021	.026	.026
4. Facilities and infrastructure					.032	.006	-.045	-.028	.091	-.020	-.022
Satisfaction											
5. Snow cover						.885**	.637**	.580**	.164**	.161**	.172**
6. Glacier extent							.655**	.551**	.146*	.151**	.134*
7. Proglacial lakes and streams								.650**	.134*	.202**	.200**
8. Vegetation									.076	.109	.165**
9. Number of people										.654**	.704**
10. Facilities and infrastructure											.803**
11. Overall experience											

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 15: Spearman correlation for scenario four.

	1	2	3	4	5	6	7	8	9	10	11
Motivations											
1. Learning		.345**	.000	-.026	-.050	-.050	-.063	.019	-.007	.095	.041
2. Sharing			.022	.030	.015	.025	.001	.025	-.036	-.016	-.015
Expectations											
3. Number of people				.197**	.059	.051	-.032	.001	.037	.038	.070
4. Facilities and infrastructure					.032	.006	-.045	-.028	-.070	-.142*	-.115*
Satisfaction											
5. Snow cover						.885**	.637**	.580**	.051	.247**	.169**
6. Glacier extent							.655**	.551**	.095	.256**	.215**
7. Proglacial lakes and streams								.650**	.087	.127*	.140*
8. Vegetation									.026	.105	.086
9. Number of people										.666**	.750**
10. Facilities and infrastructure											.813**
11. Overall experience											

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).