

Mountains on Fire: Making Sense of Change in Waterton Lakes National Park

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by

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B.Sc, Royal Roads University, 2018

Graduate Certificate in Ecosystem Restoration, Niagara College, 2016

Environmental Technician Diploma, Niagara College, 2012

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of the Requirements for the Degree of

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We acknowledge and respect the ləkʷəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day

Supervisory Committee

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Abstract

In 2017 the Kenow wildfire burned thirty-eight percent of Waterton Lakes National Park (WLNP) in southern Alberta at high to very high severity in mere hours. The ecological impacts of the fire will have implications for resource management, including the practice of ecological restoration, for decades to come.

In this thesis I ask two main questions. First, in what ways are people who are involved in managing WLNP's ecosystems experiencing the effects of the Kenow wildfire, and how does their experience combined with the severity and extent of the Kenow wildfire influence park management and ecological restoration approaches in WLNP? Subsidiary to this, I ask, what is the role of history, and the role of future climate projections in managing the post-fire landscape?

This research is part of the larger Mountain Legacy Project (MLP), which is systematically repeating historic survey photographs taken in the early 1900s across Canada's mountain landscapes. I use third-view photographs in photo-elicited semi-structured interviews with park staff to answer my first question. In my second research question I ask what broader themes and specific issues do third-view repeat mountain photographs elicit about ecological restoration and park management. As a follow up, I inquire into what ways photo-elicitation functions as an effective method in park management research? Fourteen participants were interviewed, the majority were resource conservation staff, in addition to one retired park warden, a member of the cultural resources unit, a communications staff, and a former staff member.

Participants felt wide-ranging emotions relating to the Kenow fire including grief over loss, happiness about regrowth, excitement about learning, anxiety about people's safety, and stress over increased workloads. Park management frames vegetation regeneration after the Kenow fire as renewal, accepting that the landscape may look different than it did before the fire. Climate change is only beginning to be integrated into ecological restoration, though park management is adapting to climate change by encouraging renewal under a new climate. Historical knowledge still guides decision making in several ways. Major restoration projects including invasive species management, whitebark and limber pine restoration, and prescribed burning, were all impacted by the Kenow fire. Participants shared their thoughts on unconventional approaches such as novel ecosystems, highlighting misunderstandings and misapprehensions about the concept. Parks Canada has an opportunity to learn from Waterton Lakes' experience to help streamline their post-emergency response in the future.

Findings relating to my second question show these themes and issues were discussed most often by participants when looking at the third-view mountain photographs: fire behaviour, regeneration/renewal, and ecological impacts of the Kenow fire; encroachment; prescribed burning; personal narratives; ecological effects of climate change; and other snapshots. Just less than half the participants did not engage significantly with the photos, which highlights a challenge in using researcher chosen photos. However, many participants did engage and had much to say about the photos, including sharing memories and personal stories. Pre-determined interview questions were essential in unearthing the findings in this thesis, as the photos did not elicit this information alone.

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Dedication

To my mom and dad

Chapter 1: Introduction

In 2017 the Kenow fire burned 38% (19,303 ha) of Waterton Lakes National Park (WLNP) in large contiguous patches of extreme fire severity in mere hours (Figure 1.1; Eisenberg et al., 2019; Parks Canada Agency, 2019a). It was more severe than anything on record since 1700 (Odsen, 2018) on account of a drought year and powerful winds. It was the first time a National Park has been evacuated in Parks Canada's history (K. Pearson, personal communication, March 2020). Natural regeneration is occurring after the Kenow fire in many parts of the park; meadow and grassland communities are showing high resilience to the fire (Eisenberg et al., 2019). In other places, regeneration is taking longer to get kickstarted. In the far western reaches of the park at higher elevations I witnessed large patches of still barren ground while conducting repeat photography work in 2019.

Given the far-reaching effects of climate and environmental change, it remains uncertain what trajectory some post-fire vegetation communities may take (Odsen, 2018; Stockdale et al., 2019). Studies looking at post-fire regeneration in the Rocky Mountains suggest that reduced tree regeneration is a likely possibility, especially in drier forests. This is owing to a change in average climate which is trending warmer and drier, as well as far distances to seed sources in large, burned patches (Harvey et al., 2016; Stevens-Rumann et al., 2018). Additionally, experience with system-resetting disturbance events suggest that the park is at a substantial risk for invasive species to take hold (Hobbs & Huenneke, 1992; Jauni et al., 2015). Much of the landscape in WLNP has been reset in ecological succession and there is widespread loss of organic matter and topsoil. As a result of these and other factors, the Kenow fire will have

long-lasting implications for resource conservation management and ecological restoration (Parks Canada Agency, 2019a; 2019b).

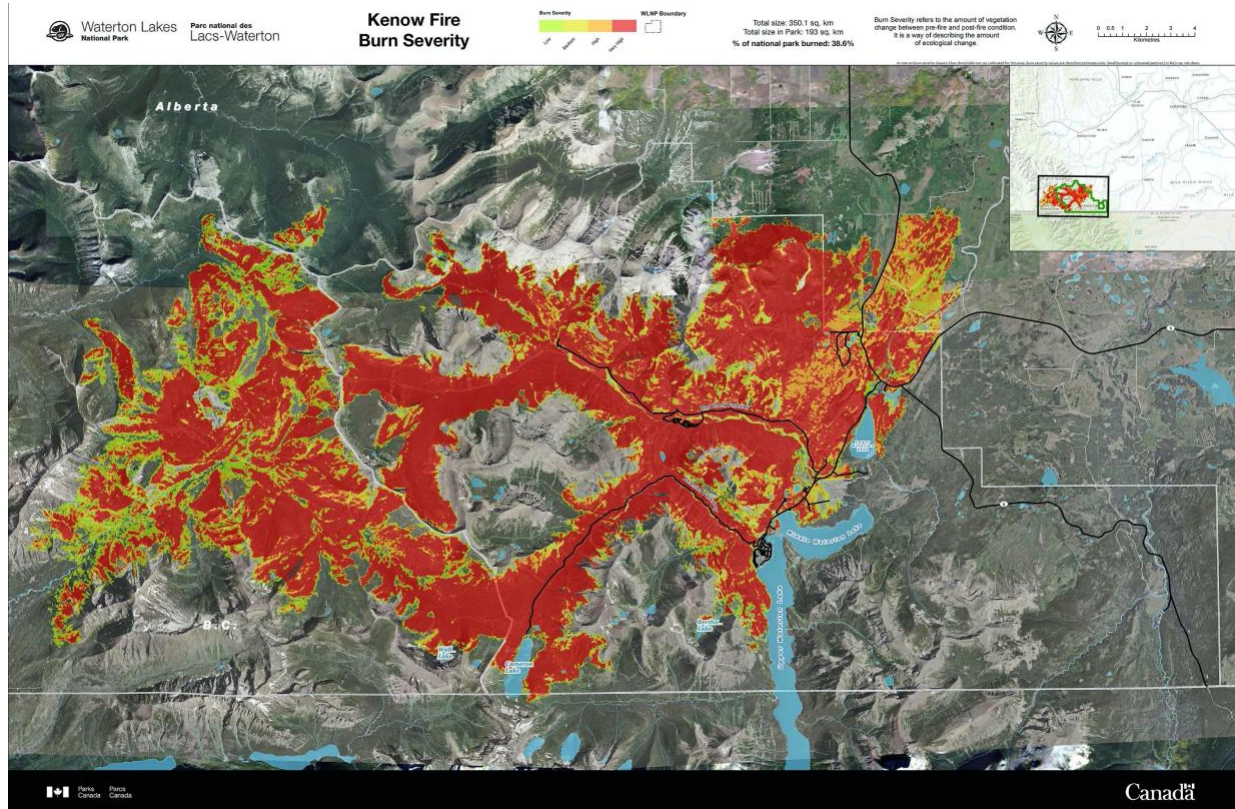


Figure 1.1: A map showing the severity of the Kenow fire in 2017. Red is very high severity, orange is high severity, yellow is moderate severity, and green is low. (Parks Canada Agency, 2019a). Very High has also been classified as Extreme Fire Severity by Eisenberg et al. (2019) meaning there was greater than 75% tree and non-tree mortality and greater than 75% exposed mineral soil and consumption of organic litter (p.7).

Understanding how park staff experienced the event, how they perceive the significant change in the park, and how they approach intervening in park ecosystems under global change spurred my interest in pursuing research here. The park has become a “living laboratory”

(Krugel, 2019) for ecologists and also an intriguing case for park management studies in an era of rapid global change. As I will discuss in following chapters, since the first national parks were created at the end of the 19th century up until today, there has been a paradigm shift in park management from managing for pristine, untouched wilderness, to active management to maintain ecological processes (such as fire) and conserve biodiversity. A perennial question in managing parks is how much and in what ways should we intervene in park ecosystems? Pressures from global change are potentially heating up discussions about the direction park management should take in the coming decades to adapt effectively, and whether more intervention, or different kinds of intervention are necessary (Lemieux et al., 2011; Lemieux, 2016; Hagerman & Satterfield, 2014). I use the newly reset landscape of WLNP as a backdrop to explore these questions.

Social science research in protected areas has explored impacts of visitation and tourism (Scott et al., 2007; Weber et al., 2019), political issues such as colonialism (Youdelis et al., 2020; Vannini & Vannini, 2019), and, increasingly, research aiming to understand how protected areas managers are considering adaptation options to global change, including climate change (Barr et al., 2020; Hagerman & Satterfield, 2013; 2014; Lemieux et al., 2011a). The management adaptation studies are typically large-scale surveys across multiple jurisdictions and what is lacking, according to Hagerman & Satterfield (2014), is more place-based research in conservation adaptation. There have been few in-depth studies exploring an individual park's experience with a significant ecological disturbance event and how the park's management is thinking about conservation adaptation and ecological restoration – which is a much-used intervention in park ecosystems - in an era of global change. My hope with this thesis is to advance a deeper understanding of the implications of extreme environmental events on the lives

of those who manage parks, and in turn how these insights can support more effective park management, through using Waterton Lakes as a case study. The knowledge gained by studying the human dimensions of conservation can help develop policy and contribute to how institutions adapt to change, and, on a deeper level, can help us better understand the story of national parks in the Anthropocene (Bennett et al., 2017). This work is part of the Mountain Legacy Project, the largest systematic repeat photography project in the world documenting landscape changes across the Rocky Mountains.

Research Objectives and Questions

This research has two objectives. First, it seeks to understand the impacts that the Kenow fire may have had on perceptions held by park staff regarding park management direction in WLNP, taking into consideration their personal lived experiences and emotional response to the changed landscape. To answer this, I approach my research from a social science perspective which is suitable for producing knowledge based on the diverse interpretations of reality by participants. Through semi-structured photo-elicitation interviews (using photos as conversation pieces and prompts in interviews), with a group of park staff, I ask my first research question: in what ways are people who are involved in managing WLNP's ecosystems experiencing the effects of the Kenow fire, and in what ways does their experience combined with the severity and extent of the Kenow fire influence park management and ecological restoration approaches in Waterton Lakes National Park? In other words, in what ways does their experience with the fire shape their attitudes toward intervening in park ecosystems in the form of ecological restoration? Further to this, I ask, what is the role of history, and the role of future climate projections in managing the post-fire landscape?

Ecological restoration was chosen as the intervention I focussed on because it is a form of intervention embraced by Parks Canada; they have policies and guidelines for its practice (Parks Canada Agency, 2008) and a national Conservation and Restoration program (CORE) that many parks participate in (Parks Canada Agency 2019c).

This research falls within the Mountain Legacy Project (MLP), one of the world's largest systematic repeat photography projects, houses a collection of 120,000 historical survey photos and over 9,000 repeat photos throughout the eastern slopes of Canada's Rocky Mountains. The MLP aims to provide high resolution historical information on mountain ecosystems in support of restoration science and practice. There is excellent coverage of Waterton Lakes National Park with these historical photographs. The MLP repeated all the historical photos in 2004 and 2005, and returned for a third time in 2019 to capture another moment in time after the Kenow fire (www.mountainlegacy.ca).

My second research objective is to examine the effectiveness of using repeat mountain photographs in the photo-elicitation method that I employ to answer my first question. The use of repeat mountain photographs has seldom been used in photo-elicitation, especially not in a park context. For my second research question, I ask: what are the broader themes, and specific issues, that repeat mountain photographs can elicit around ecological restoration and park management? And in what ways is photo-elicitation an effective method in park management research?

Thesis Organization

Following this brief introductory chapter, Chapter 2 will provide background on global change impacts on parks and protected areas, park management approaches including ecological

restoration; and proposed ways of adapting to global change. In Chapter 2 I will describe the evolution of survey photography and its use in National Parks, including in the Mountain Legacy Project. In Chapter 3 my focus is on methodology for both research questions, going into depth about photo-elicitation and its methodological considerations. I report in Chapter 4 on findings of my first research question, followed by Chapter 5, which addresses findings from my second question. Chapter 6 is a synthesis of the entire thesis, and where I present recommendations and future research pathways. Before moving on to Chapter 2, I will briefly describe in more detail the site of my research, Waterton Lakes National Park.

A Note on the Study Area

The placement of any park in the broader landscape is important to understand because ecological processes ignore park boundaries. Waterton Lakes National Park (WLNP), the fourth national park established in Canada, is a relatively small 505 km² protected area located in the southwest corner of the province of Alberta, Canada (Figure 1.2) which is known to be “where the prairies meet the mountains” (Parks Canada Agency, 2008b). WLNP is in the Rocky Mountain Region and comprises four natural subregions: foothills parkland, montane, subalpine, and alpine (Parks Canada Agency, 2010). Together, WLNP and Montana’s Glacier National Park to the south form an International Peace Park and UNESCO World Heritage Site and both parks are embedded in the much larger Crown of the Continent Ecosystem that spans the Rocky Mountains from Montana to Alberta and British Columbia (Manners, 2016; Parks Canada, 2010). The eastern border of the park is adjacent to ranch lands, managed in cooperation with the Nature Conservancy of Canada to help achieve biodiversity conservation goals. Being surrounded by protected areas and cooperatively managed ranch lands provides an ecological

buffer that a small park surrounded only by development would lack. However, WLNP is one of the few Canadian National Parks that has a town within the park boundaries. The presence of the town adds unique challenges in managing for ecological integrity, as it is a concentrated source of stressors such as invasive species, pollution, and noise, and a hotspot for potential human wildlife conflict (Parks Canada Agency, 2000).

Before the park became Canadian federal jurisdiction, the Blackfoot (Nitsitapi) peoples including the Kainaiwa, Piikani, and Siksiwa lived on the landscape for at least 10,000 years, and continue to have relations with the land (MacDonald, 2000; Shockley, 2019). The area was an important area for trade and provided relatively easy travel across the Akamina Pass into what is now British Columbia (B. Parry, personal communication, March 2020). Indigenous peoples tended the landscape with low-intensity fire to clear brush and encroaching trees in the grasslands for improved hunting, to improve berry cultivation, and to produce materials for basket weaving, among many other uses (Reeves and Peacock, 2001). People were drawn to this place and lived off the land for millennia, rich cultural histories developed alongside its diverse and rich ecology. In fact, topsoil that was lost from the Kenow fire created an unprecedented opportunity for more archaeological discovery (Shockley, 2019).



Figure 1.2: Waterton-Glacier International Peace Park, showing WLNP in yellow and the townsite highlighted with a star (Parks Canada Agency, 2020)

Fire is a natural process in WLNP. The historic fire regime was characterized by longer fire return intervals in the higher elevation subalpine, and more frequent fires occurring in the lower elevation montane and foothills parkland (fescue prairie), many of which were lit by Indigenous peoples (Barrett, 1996). Fire suppression began in the late 19th century which was a practice that reflected the values of the time, mainly that “wilderness” should be preserved and not damaged by processes such as fire. There were, however, wildfires in 1919 and 1935 that occurred in drought years, the latter started in Glacier National Park and burned into the

Boundary Creek area of WLNP (Barrett, 1996). In 1940 highly effective fire suppression policies were in place and 90% of fires that started between 1940 and 1995 were successfully extinguished. According to Barrett (1996), if fires were not suppressed during the period of 1940 to 1995 in the fescue prairie, 67,000 hectares would have burned. In his fire history, Barrett (1996) suggests that fire suppression policies created a situation on the landscape where there was more contiguous forest and available fuel, stating that a significant fire event was “imminent” for WLNP. All this to say that land management regimes are not static and will shift according to the values of society and available knowledge.

The following chapter will provide background context for the issues explored in this thesis including global change impacts on national parks, park management approaches, ecological restoration and post-fire management, the human dimensions of conservation, and a brief history of scientific photography.

Chapter 2: Setting the Stage

The purpose of this chapter is to provide background on the scholarly literature underpinning my research. In this chapter I examine how global change is impacting national parks and how it is changing how parks are managed. I describe park management approaches and philosophies, go into depth about ecological restoration as an active management intervention, and discuss the intersection of ecological restoration and post-fire management. I describe the human dimensions of conservation and how inextricable links between people and place are being challenged by global change. In the last part of this chapter, I examine survey photography and its role in shaping national park culture, and how repeat photography has emerged as a way to understand landscape change from ecological and social perspectives.

Global Change and National Parks

For decades studies have illuminated how much humanity has altered the structure and functioning of ecosystems through actions resulting in a warming climate, wholesale land-use change, invasive species proliferation, biodiversity loss, nitrogen and phosphorus deposition, and ecosystem service degradation (Diaz et al., 2019; IPCC, 2018; MA 2005; Steffen et al, 2015). The average temperature of the earth continues to rise (IPCC, 2018) and one consequence of climate change is that fire seasons are getting longer, lengthening by 18.7% globally between 1979 and 2013 (Jolly et al., 2015). Australia had its driest year on record in 2019 which was followed by a nightmarish fire season that burned 17 million hectares of land including millions of hectares in national parks, having serious social-ecological impacts including human and non-human mortality (Richards, Brew, & Smith, 2020).

More wildfires are expected for western North America (Schoennagel et al., 2017; Westerling, 2006) and this trend can be seen happening in Canada already with increasingly longer fire seasons, more large fires and more area burned since 1959 (Hanes et al., 2019). British Columbia (BC), Canada, had two back-to-back record-breaking fire seasons in 2017 and 2018, burning 1.2 and 1.35 million hectares, respectively (Government of British Columbia, 2019). Kootenay National Park in BC burned just over 18,000 hectares in 2017, the same year as the Kenow fire.

In addition to a warming climate, legacies of past management in the form of fire suppression have increased fire risk in ecosystems where low fuels were historically maintained by low-severity frequent fire; these include low to mid elevation ecosystems under low-severity and mixed severity fire regimes (Schoennagel et al., 2004). Fire suppression policies led to an increase in fuels and an increase in fire severity (Schoennagel et al., 2004). By contrast, in subalpine ecosystems, fire suppression is not a factor that has increased fire risk because subalpine ecosystems are more controlled by climate than fuels, thus increased prevalence of droughts under a warming climate is more of a risk for increased fire (Schoennagel et al., 2004).

National parks represent ecosystems that are characteristic of a country's diversity and will play an increasingly important role in safeguarding biodiversity in an era when over 1 million species are at risk of extinction and invasive species are widespread (Diaz et al., 2019; Vila et al., 2011). Research in the US revealed that climate change will disproportionately affect its 417 national parks as many of them are at high elevations, in arid and arctic regions (Gonzales et al., 2018). Many of Canada's largest parks are in the Arctic and the high elevation Rocky Mountain range, with the latter parks being some of the most iconic and most visited (Nature Conservancy of Canada, 2020; Parks Canada, 2019). Canada is warming at twice the global rate

(Zhang et al., 2018), and the Arctic at more than twice the global average (Meredith et al., 2019) which may amplify climate change impacts in these regions. Species are expected to redistribute themselves to higher elevations and latitudinally under climate change (I Ching et al., 2011). This will have ramifications for society and parks and protected areas. Parks and protected areas and governments at all levels across the globe will need to prepare effective policies for dealing with inevitable species redistributions under climate change that go beyond current species at risk agreements (Scheffers & Pecl, 2019).

Climate change may also impact visitation to parks in numerous ways. For example, climate change could increase visitation to national parks with warmer temperatures in spring and fall extending nice weather, which could put further pressure on the ecological integrity of park ecosystems (Scott et al., 2007). By contrast, ecological impacts from climate change could potentially reduce visitation if visitor experience would be compromised. If glaciers have melted, wildlife are extirpated or go extinct, recreational activities such as skiing, fishing, or camping (and campfire bans) are impacted, or if place attachment is generally affected by changing habitat and degradation, visitation could diminish (Lemieux, 2016; Scott et al., 2007).

Despite much scholarship on how climate change should be taken into account in park management (Lawler, 2009; Lemieux et al., 2011; Lemieux, 2016), little progress has been achieved regarding actual policy change, and especially because funding, scientific and human resource capacity aren't sufficient to address adaptation strategies (Barr et al., 2020; Lemieux et al., 2011). A 5-step Climate Change Adaptation Framework to guide protected areas management in Canada was refined from workshops held across the country from 2017-2019 and published in 2020 by Parks Canada and the Canadian Parks Council, though it remains to be seen how it will be implemented (Nelson et al, 2020). The ways in which parks agencies

approach novel problems and the increasing pressures of global change will be important to critically reflect on and learn from in the coming decades. The frameworks used to manage parks will need to be continually reviewed and adapted to ensure they can adequately address change and preserve ecological integrity (Lemieux, 2016; Lemieux et al., 2011; Lemieux & Scott, 2011; Hagerman & Satterfield, 2014; Nelson et al., 2020).

Management Approaches - Active? Passive? Adaptive?

The prevailing philosophy guiding park establishment in North America in the late 19th and early 20th century was that parks could be left alone and preserved in perpetuity, primarily for the economic benefit of tourism and recreation in Canada, and for the public trust and opportunities for self-education in the US (Cole & Yung, 2010; Dearden & Dempsey, 2004; Warner, 2008). Protected areas were historically managed to preserve natural, or “pristine,” conditions. This was true in the United States and also in Canada where, in the first National Parks Act in 1930, parks were created for the enjoyment of Canadians and were to be preserved “unimpaired for the benefit of future generations” (Needham et al., 2016). However, the pressures of global change and a deeper understanding of the dynamic nature of ecology have forced a shift away from the preservation ethic, where drawing a boundary around a place was sufficient to achieve naturalness and historical fidelity in perpetuity. Societal values have also directed a shift away from tourism being the prime focus of parks in Canada (Dearden & Dempsey, 2004; Needham et al., 2016). In the past several decades, park management has shifted toward increasing human intervention in ecosystems, actively managing for intact ecological processes, and ecological integrity as the first priority (Aplet & Cole, 2010; Dearden & Dempsey, 2004; Theberge, Theberge, & Dearden, 2016). With that being said, nature

“preservation” in the form of increasing the amount of protected areas is still a strategy for ensuring ecological integrity across fine and coarse scales in the face of diminishing natural areas worldwide (Millennium Ecosystem Assessment, 2005; Needham, Dearden, Rollins & McNamee, 2016). Additionally, there are an increasing number of national and global commitments for increasing protected areas such as the Canadian government’s commitment to protecting 30% of land and water by 2030 (CPAWS, 2020).

In Figure 2.1, Aplet & Cole (2010) illustrate four common pathways for park ecosystem management. Aplet & Cole (2010) place these ecosystem stewardship options along two axes: self-willed to controlled, and novel to pristine (Aplet & Cole, 2010). In the past it was possible to passively allow ecosystems to recover, or to use ecological restoration to restore them, to pristine conditions that have high historical fidelity. Figure 2.2 illustrates that under pressure from global change, passive recovery to a self-willed, pristine condition is likely not possible and that encouraging self-willed ecosystems will necessarily mean accepting change from a pristine historical condition.

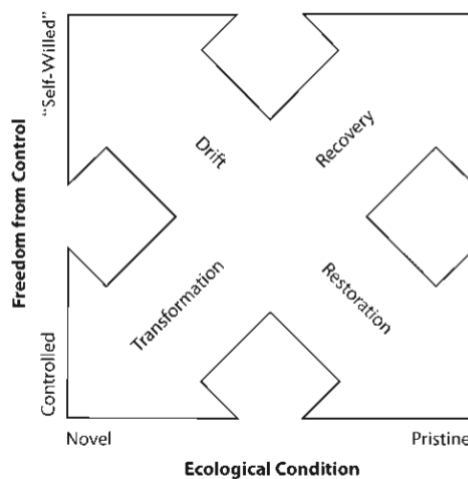


Figure 2.1: Showing ecosystem stewardship options along gradients from novel to pristine, and self-willed to controlled (Aplet & Cole, 2010).

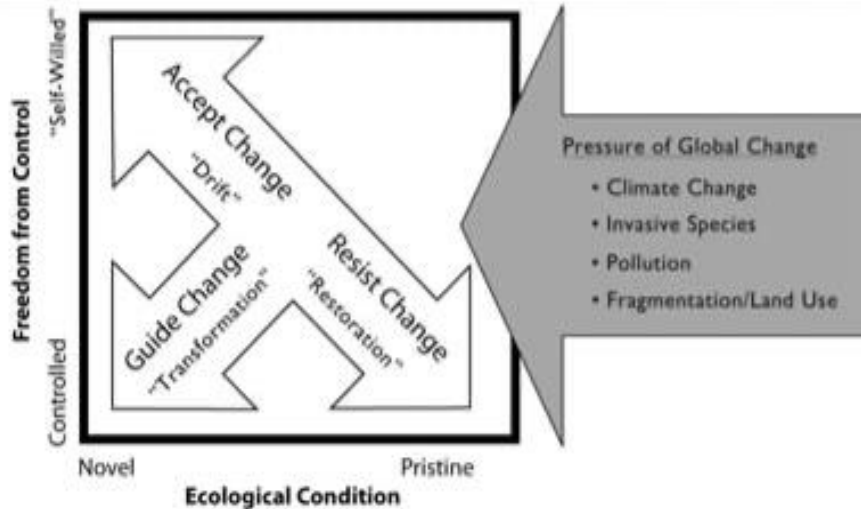


Figure 2.2: Ecosystem stewardship options change under pressures of global change (Aplet & Cole, 2010).

A diversity of approaches to parks and wilderness management were advocated by authors of *Beyond Naturalness* to move beyond the ambiguous goal of managing for pristine natural conditions (Cole & Yung, 2010). In the book the authors elucidate the nuances of “naturalness.” Three meanings emerge: pristine with no visible human presence on the landscape; not controlled by humans for any goal, self-willed and autonomous; or a strong degree of historical fidelity to the conditions of the protected area when it was established (Aplet & Cole, 2010). Naturalness is not only ambiguous, but is problematic in that it disregards millennia of Indigenous presence on the land (Aplet & Cole, 2010). The management options discussed in the book included managing for historical fidelity, resilience, ecological integrity, and nature’s autonomy (self-willed). Not one singular approach was said to be ideal, but rather all of them could theoretically be implemented across a park to address different ecosystems and situations (Cole & Yung, 2010).

Cole, Higgs, & White (2010) define historical fidelity as a management goal as being “true to the past” regarding species composition and structure (p.127), and state that historical fidelity could be pursued for several different reasons such as biodiversity conservation or more culturally specific reasons like nostalgia, sense of place, and time depth (appreciation of the continuity of ecosystems, old-growth forests, for example). Historical fidelity as a management goal requires considerable effort and resources and is thus best suited for small scale interventions targeted to save particularly significant species (Cole et al., 2010) such as whitebark pine (*Pinus albicaulis*). Higgs (2012) describes historical fidelity as “historicity,” meaning “The quality of thinking historically” (p.81), and argues that it is a virtue in the practice of ecological restoration which I will describe in more detail in the next section.

Managing for resilience can be in both environmental and social spheres, and is generally trying to enhance the capacity of the system to absorb stress (invasive species, disturbance, climate change, political change) by encouraging diversity, redundancy, and interconnectedness across small and large scales (Zavaleta & Chapin, 2010). It is up to park management and the public to determine what they are managing to be resilient to change, for example: intact food webs, native plant biodiversity, or specific cultural experiences (Zavaleta & Chapin, 2010).

The first priority for the management of national parks in Canada is the “maintenance or restoration of ecological integrity” (Dearden & Dempsey, 2004). It was first put into policy in 1964 and then written into legislation in the revised National Parks Act of 1988 (Dearden & Dempsey, 2004). In the new National Parks Act of 2000 it was firmly cemented in and defined as being “a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes” (Canada National Parks Act

S.C. 2000 c.32, s. 2(1); Dearden & Dempsey, 2004). Active management is embraced in Parks Canada's Guiding Principles from 1994 when the structure and functioning of an ecosystem is threatened, but minimizing the amount of interference in park ecosystems is still the ideal according to Theberge et al. (2016). In Parks Canada, active management is "any prescribed course of action directed toward maintaining or changing the condition of cultural, physical, or biological resources to achieve Parks Canada agency objectives" (Theberge et al., 2016; p.86). In Banff National Park, for example, plains bison (*Bison bison bison*) were reintroduced to fulfill important ecological functions and achieve ecological integrity (Parks Canada Agency, 2017). Additional goals of the reintroduction were to support the resilience of cultural relationships between indigenous peoples and bison, and historical fidelity, as bison had been present on the landscape for millennia (Parks Canada Agency, 2017).

Adaptive management is a "learning by doing," experimental approach to management and ecological restoration that is practiced by Parks Canada (PCA, 2008, p.61). Active adaptive management embraces practices such as assisted migration, prescribed fire and controlling invasive species to "maximize the capacity" (Lemieux et al., 2011b, p.935) for ecosystem adaptation to climate change. Management actions are monitored for their effectiveness and adapted as needed to achieve desired outcomes (Parks Canada Agency, 2008). Passive adaptive management monitors the system as new data emerges (Lawler, 2009), and generally refrains from active intervention because managers choose to allow for the natural capacity of species to adapt to climate change themselves (Lemieux et al., 2011b). Lemieux et al. (2011b) & Lawler (2009) advocated for adaptive management or a hybrid management regime incorporating both passive and active adaptive management to guide adaptation to climate change. In other words, and similar to the authors of *Beyond Naturalness*, diverse approaches are required across the

landscape depending on the ecosystem in question, the resources available, and the values of managers and the public. Passive management may be appropriate when the scale of the problem is too large to address through active management (Lawler, 2009) or when managers are trying to encourage ecosystems to evolve under climate change (Lemieux et al., 2011b).

Despite the increasing need for more intervention in park management to achieve ecological integrity, there are still advocates for encouraging nature's autonomy, albeit mainly in US park literature. In *Beyond Naturalness*, Landres (2010) elucidates what a hands-off, "let it be" approach to protected areas management looks like and describes three factors to consider in determining situations that a hands-off approach is best suited for: whether the legislative mandate for the protected area is in alignment with wildness as a goal; the ethics and values of managers; and whether there is adequate knowledge available to make management decisions. For example, Parks Canada is legislatively mandated under the Species at Risk Act to intervene to conserve species-at-risk (Government of Canada, 2012), which would render a fully hands-off approach not appropriate in many cases (Landres, 2010).

Autonomy of nature can also be thought of as wildness (Landres, 2010). It is the ability of an ecosystem to evolve as it is self-willed to evolve, free from human manipulation, and the freedom to do so unhindered by constraints external to the system (Woods, 2005, as cited by Landres, 2010). External constraints in WLNP, for example, would be the high threat of invasive species by being adjacent to agricultural lands, along with anthropogenic climate change. To summarize an important driver of choosing the hands-off approach, Landres (2010) writes, "By willfully not manipulating or intervening in ecological systems, the hands-off approach is a way to foster greater respect and humility toward the autonomy of nature" (p.101). Further to this

point, he explains, “the goal of the hands-off approach is to not intervene even if some of these elements [historic fidelity, resilience, or ecological integrity] are lost” (91).

This section has provided a brief look at the evolution of the way parks and protected areas have been managed in Canada. In the past century park managers realized simply outlining a place on a map and leaving it untouched by human hands and development was not sufficient to conserve ecological values in and of itself, and accepted that people had to be actively involved in managing ecosystems. Numerous management approaches were outlined that are applicable to park management today, and applicable to different situations. The evolutionary trajectory of park management is bound to continually change, and I will outline some of the shifts that can already be seen emerging in the literature in the next section, specifically in the practice of ecological restoration.

Ecological Restoration and National Parks

The practice of ecological restoration as a response to degradation from human activities has been adopted by protected areas worldwide as an active management intervention to achieve ecological integrity (Keenleyside et al., 2012). Ecological restoration is ‘the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed’ according to the Society for Ecological Restoration (SER, 2004, p.3). The SER International Principles and Standards provide guidance to practitioners of ecological restoration globally (Gann et al., 2019). Allowing for “natural regeneration” is one of three broad approaches to restoration that the SER advocate for (Gann et al., 2019). Natural regeneration is a passive approach that would be appropriate for situations where there is enough time to allow ecosystems to regenerate, there are intact ecosystems surrounding the damaged area to supply propagules, and there is generally a

low amount of damage to the ecosystem. The other approaches are assisted regeneration (moderate damage) which combines the passive approach with active intervention, or the full reconstruction approach (high damage; Gann et al., 2019).

The Parks Canada Agency (PCA) uses ecological integrity as the basis of a science-based, measurable monitoring program involving a suite of indicators to guide management action (Wurtzebach & Schultz, 2016). The condition (poor, fair, or good) of the indicators (forests, grasslands, wetlands, as examples) informs what areas of the park will be prioritized for ecological restoration (Woodley, 2010; Wurtzebach & Schultz, 2016). The Parks Canada Agency (PCA) has been a global leader in developing ecological restoration and park management policies. The PCA's 2008 Principles and Guidelines for Ecological Restoration were the first such national-level policy in the world, and formed part of the basis for international protected areas restoration guidance developed by the International Union for the Conservation of Nature (IUCN; Keenleyside et al., 2012; Parks Canada Agency, 2008). Parks Canada embraces the SER's definition for ecological restoration, and adds that "the goal of ecological restoration is to initiate, re-initiate, or accelerate processes that will lead to the evolution of an ecosystem that is characteristic of a protected area's natural region" (p.14). While ecological restoration is practiced by Parks Canada, avoiding the need for restoration in the first place through preventing degradation takes precedence (Parks Canada Agency, 2008).

A key part of the ecological restoration process in national parks is to meaningfully engage stakeholders and visitors in all aspects of the process as it enhances stewardship, offers opportunities to learn, and increases the potential for successful restoration projects (Parks Canada Agency, 2008). The 2008 guidelines cite Higgs (1997): "in order for it [ecological restoration] to avoid becoming a passing fad, it must ... depend on the development of authentic

engagements between people and ecosystem; in other words, the development of a heightened place awareness” (p.13). Engagement in the form of consultation with the public, stakeholders, and Indigenous partners in the planning phase of restoration projects is important for the long-term success of the project and for identifying mutually agreed upon ecological and cultural resource values that are the goals of restoration. The guidelines advise that restoration should be informed by science and Traditional Ecological Knowledge (TEK; called Aboriginal Traditional Knowledge, ATK, at the time). Finally, effective restoration will consult with the cultural resource department to ensure that restoration projects do not undermine cultural resource integrity (Parks Canada Agency, 2008, p.26-67).

Nascent ecological restoration from the late 1980s to the early 2000s had a strong focus on historical fidelity, aiming for a historic baseline community composition and structure typically from pre-industrial times (Cole et al., 2010; Higgs, 2012; Higgs et al., 2014). In the context of rapid anthropogenic climate and landscape change, the way in which history informs present decisions has changed from being a prescriptive template to a trustworthy guide, and will continue to change (Higgs, 2012; Higgs et al., 2014). Analogous to the paradigm shift in park management from managing for pristine natural conditions in perpetuity to managing for ecological integrity, ecological restoration as a practice has also shifted to be focused more on restoring ecological processes such as disturbance regimes rather than composition and structure (Higgs et al., 2014).

Higgs et al. (2014) described nine ways that history is still relevant to ecological restoration (Figure 2.3), falling under three broader categories: “history as information or reference”; “history as enriching cultural connections”; and “history as revealing the future” (p.501). For example, there will continue to be attentiveness to reference communities and we

will continue to learn from historical ecosystem shifts to guide present decision making. History will help inform models of future change and help temper human ambition in a technological age (Higgs et al., 2014). Higgs et al. (2014) argue that paying attention to history is more important now than ever and infuses the qualities of self-restraint, humility, and respect for nature into ecological restoration. Higgs (2012) explains that historicity and ecological integrity are the “moral centres of gravity for ecological restoration” (p.98).

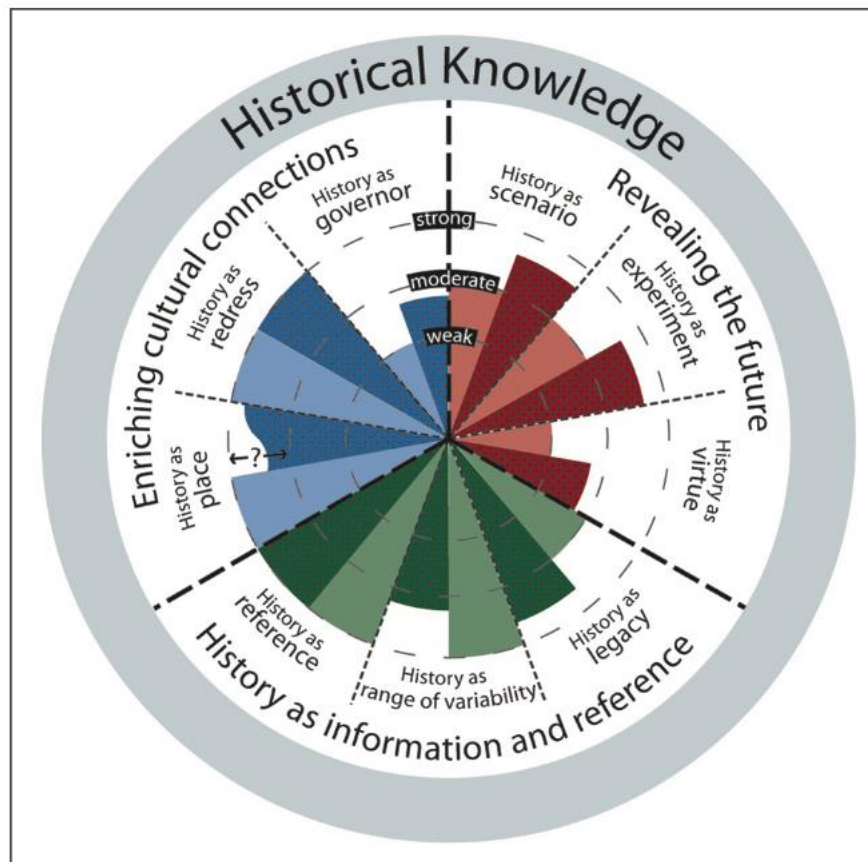


Figure 2.3: A wheel showing nine types of relevant historical knowledge and their present (lighter shade) and predicted future roles (darker shade) in the practice of ecological restoration. The roles are organized under three broad categories: “history as information or reference”; “history as enriching cultural connections”; and “history as revealing the future”. Reprinted from “The changing role of history in ecological restoration” by E. Higgs, D.A.

Falk, A. Guerrini, M. Hall, J. Harris, R.J. Hobbs, S.T. Jackson, J.M. Rhemtulla, & W. Throop, 2014, *Frontiers in Ecology and Environment*, 12(9), p. 504. Copyright 2014 by the Ecological Society of America.

With a growing recognition of the challenges involved in restoring historic ecosystem states in the current era of global change, more flexible ways of approaching restoration, and by extension conservation management, have been recommended by many ecologists and philosophers (Hobbs et al., 2013). These approaches can be grouped under what Hagerman & Satterfield (2014) describe as unconventional, or interventionist approaches. By contrast, conventional approaches to park management typically include minimizing stressors and threats to ecosystems such as pollution and invasive species, restoring habitat and native species, increasing park area and connectivity, and collaborating with the surrounding non-park landscape to achieve biodiversity conservation goals (Hagerman & Satterfield, 2014; Lawler, 2009). Unconventional approaches include practices such as assisted migration, conservation triage, or managing for novel ecosystems (Hagerman & Satterfield, 2014; Lawler, 2009; Hobbs et al., 2013). Conservation triage is parallel to medical triage where patients are prioritized based on the urgency and severity of their needs, or whether they can be saved at all (Lawler, 2009). In assisted migration, people move species beyond their current ranges to areas predicted to be more suitable under climate change when they will not be able to move fast enough on their own and are threatened with extinction or extirpation (Lawler & Olden, 2011). The novel ecosystem approach acknowledges when social or ecological thresholds have been crossed making returning to the historical trajectory infeasible and an inefficient use of resources, thus managing for biodiversity and ecological processes, both native and novel, may be a better path (Hobbs et al., 2009; 2013; Morse et al., 2014; Heger et al., 2019). Ecological novelty is a more recent

umbrella concept elucidated by Heger et al. (2019) to describe and study novelty emerging across scales, from the organism to landscape, and not just at the ecosystem scale. Heger et al. (2019) argue that ecological novelty, as an umbrella term, avoids the provocative debates that have encircled the term novel ecosystem over the past decade (Hobbs et al., 2013; Murcia et al., 2014), and offer a research framework that is a practical path forward to address inevitable novelty.

These unconventional approaches have been suggested to be ways for protected areas to adapt to climate change (Lawler, 2009; Lemieux et al., 2011b). For example, Lemieux et al. (2011b) stated that a key role for ecological restoration in parks and protected areas adaptation to climate change is to “provide for artificial translocation or assisted migration (e.g., such as by planting future-adapted species” (p.936). While studies show that park managers recognize climate change adaptation needs to happen soon (Barr et al., 2020; Lemieux et al., 2011; Hagerman & Satterfield, 2014), a clear path forward is lacking and there is some discomfort in those surveyed about using unconventional strategies. Hagerman & Satterfield (2013; 2014) surveyed experts in conservation on the degree to which they agree with and prefer the aforementioned unconventional management actions. They found that 97% of experts agreed that conservation triage will be necessary to address climate change impacts, 95% agreed species losses are an inevitability, 68% said that historical baselines are becoming less relevant, and 65% said definitions of non-native species need to be revised. Furthermore, 99% agreed that maintaining ecological processes was the most important goal for conservation, of higher importance than protecting specific species for economic or cultural value. Despite this, most experts still showed preference for conventional management approaches of expanding park boundaries, increasing connectivity, reducing stressors, and working with peripheral areas to

enhance biodiversity protection outside the park over unconventional approaches. Barr et al. (2020) found comparable results regarding preference for conventional rather than unconventional management activities. Importantly, Hagerman & Satterfield (2014) discuss a paradox that exists among the experts they surveyed, in that most agree that decisions will have to be made under uncertainty, but also that uncertainty is a barrier to making decisions around adaptation.

Hagerman & Satterfield (2013; 2014) are not arguing that conventional approaches should be abandoned, but rather that these approaches may not be up to the task of climate adaptation on their own or adequate to address anticipated global changes like widespread species relocations or species struggling to move with the changing climate. Furthermore, and perhaps most importantly, the authors cautioned that too much emphasis on conventional approaches could draw the focus away from much needed conversations around how priorities will be set (for triage, assisted migration, managing for novelty) under rapidly changing conditions (Hagerman & Satterfield, 2014). Hagerman & Satterfield (2013) attributed the surveyed experts' preferences for conventional actions to positive feelings toward them, pro-ecological (wilderness) values rather than exhibiting hubris in managing nature, and that these actions are perceived as less risky and more ecologically effective. To my knowledge there have not been any other studies assessing perceptions of novel ecosystems in management of Canadian parks and protected areas.

Similar to assisted migration and conservation triage, the novel ecosystem concept is hotly provocative because it forces us to determine our comfort levels in shaping nature (Hagerman & Satterfield, 2013; Lawler & Olden, 2010; Standish et al., 2013). Critical perspectives offer that frameworks already exist for prioritizing where ecological restoration

should occur to use resources efficiently, rendering the novel ecosystem concept futile (Murcia et al., 2014). For example, ecological integrity is the first priority for managing national parks in Canada and the Parks Canada State of the Park report from 1997 acknowledges that “Ecosystems are inherently dynamic and change does not necessarily mean a loss of integrity. Systems with integrity may exist in several states, but the change occurs within acceptable limits. Outside these limits, the ecosystem loses integrity” (p.23). The challenge for parks according to Lemieux (2016) will be to determine the degree of novelty that falls within “acceptable limits” (p.434) and whether the concept of ecological integrity itself should be defined in a way that is less tied to history (Wurtzebach & Schultz, 2016).

Ecologist Monica Turner (2010) says to expect surprises and novel ecological trajectories after disturbances in an era of global environmental change. Some parks scholars contend that novel ecosystems will be part of the reality for many parks in the future and should be considered in adapting park management frameworks to climate change (Keenleyside et al., 2012; Lemieux, 2016; Wurtzebach & Schultz, 2016). The novel ecosystems framework has not been explicitly adapted by protected areas in Canada. However, it is a consideration in the IUCN document (Keenleyside et al., 2012): “In some systems (e.g. those experiencing climate change) acceptance of new biotic assemblages or novel ecosystems may be necessary and restoration efforts may focus on achieving functionality, resilience, diversity or other agreed-upon objectives of the new ecosystem” (p.28).

Wildfires such as the Kenow fire present both opportunities and challenges for the practice of ecological restoration, and there are existing policies and guidelines to inform decision making that are outlined in the next section.

Post-Fire Regeneration and Ecological Restoration

It has been suggested that wildfires may create opportunities for ecological restoration (Leverkus et al., 2019). Wildfires can remove dense forest canopies, providing opportunities for: planting native species that were previously suppressed, planting species that are adapted to future climates, conducting assisted migration, or allowing passive restoration of vegetation communities (Leverkus et al., 2019). Following a natural disturbance event, the principles and guidelines for ecological restoration in both the Parks Canada (2008) and IUCN (Keenleyside et al., 2012) documents recommend allowing natural recovery to happen if ecological integrity can be measured “within a reasonable timeframe” and to avoid attempting any large restoration projects in the affected area (Keenleyside et al., 2012, p.25; Parks Canada Agency, 2008). They advise allowing natural regeneration to occur unimpeded and suggest intervening only when vulnerable species or ecosystems are threatened, public safety issues need to be addressed, or if natural regeneration threatens local communities (Keenleyside et al., 2012). Managing the public after natural disturbances is important for public safety and for maintaining ecological integrity. Keenleyside et al. (2012) advise closing certain areas of the park if necessary and keeping the public informed about the natural disturbance and how they can help minimize risks to vulnerable areas (p.25).

Beschta et al. (2004) and Noss et al. (2006) outlined considerations for ecological restoration after wildland fires, noting that sometimes fires can be seen as catastrophic or disastrous and thus needing restoration, but little restoration is actually needed. No restoration was needed after the Yellowstone fires of 1988 as there were very few sources for invasive species and ecosystems remained within the natural range of variability with ecological integrity

intact (Romme & Turner, 2004). Beschta et al. (2004) state, “Thus, a crucial priority of postfire management is enhancing the capacity of burned areas to recover naturally” (p.959).

Attempts at restoring through seeding, grazing, or salvage logging, as examples, can create additional stresses to ecosystems in many cases (Beschta et al., 2004, p.959). One example discussed by Beschta et al. (2004) is that of hydrophobic soils, or soils that have lost organic matter and have dried out substantially after severe fires, causing erosion issues (Beschta et al., 2004). Restoration through disturbing these soils by mechanical means has been suggested as a way of restoring the soil’s capacity for water infiltration. However, attempting restoration of this kind would cause soil compaction and amplify erosion, degrading soils further, therefore it is best to let soils regenerate naturally.

With that being said, restoring impacts on the landscape from firefighting efforts such as bulldozed lines or areas where fire retardant was used are of high priority after wildfires to minimize adverse effects of pollutants, minimize soil compaction, and maintain habitat connectivity (Beschta et al., 2004). Additionally, a post-wildfire setting where there is reduced tree canopy and competition from other vegetation is the optimal time to plant rust-resistant whitebark pine seedlings to enhance their restoration across the landscape (Keane et al., 2017). This restoration is needed after decades of devastating effects from white pine blister rust (*Cronartium ribicola*), a non-native fungal disease, and mountain pine beetle (*Dendroctonus ponderosae*) infestations that have caused significant declines in whitebark and limber pines across the Rocky Mountains (Keane et al., 2017). These trees are a keystone species that provide important habitat for wildlife such as grizzly bears who feed on their nutrient rich cones (Keane et al., 2017).

A post-fire setting can also be opportunistic for managers who want to restore historical fire regimes that confer resilience and resistance to future severe wildfires, in contrast to the altered fire regimes many parts of the Northern Rockies experienced through fire suppression and forest management practices in the twentieth century (Hessburg et al., 2019). Hessburg et al. (2015) offered seven principles for restorative landscape management of fire prone forests. These principles include: “regional landscapes function as multi-level, cross-connected, patchwork hierarchies” (1); “topography provides a natural template for vegetation and disturbance patterns” across scales (2); “disturbance and succession drive ecosystem change” (3); and “predictable patch size distributions historically emerged from linked climate-disturbance-topography-vegetation interactions” (4) (Hessburg et al., 2015). In summary, they urge managers to restore disturbance regimes to achieve successional heterogeneity at the landscape and patch scale. They suggest using topography as a guide and applying different treatments such as prescribed fire, thinning, or managed wildfire, on north and south aspects. For example, according to Hessburg et al. (2019), enhancing the frequency of fire back to historical levels in dry forest types will reduce fuel buildup and infilling of shade tolerant trees which would otherwise be likely to cause more severe and large fires in the future. Managing fire in this way would help restore the characteristic open forest and tree clumps and restore the presence of large diameter trees which are important habitat features and seed sources (Hessburg et al., 2015).

Hessburg et al. (2015) suggest that species and ecological processes will adapt to climate change in this way and the landscape will be more resilient to future wildfire and bark beetle disturbances. In a similar vein, Millar et al. (2007) outlined forest management options in the face of climate change to encourage either resistance, resilience, or adaptation. To encourage

adaptation to climate change, they suggest that resetting succession at different times across the landscape can diversify stand ages, species compositions, and ecosystem structure, and create early successional conditions that are best suited to adapt to the climate they are growing in (Millar et al., 2007). If the entire landscape regenerated at the same rate, it would increase future vulnerability to changes in climate such as extended droughts, whereas if there were diverse patches at different stages of succession responses to the drought may vary among patches and mortality may not be as widespread (Millar et al., 2007). Managers can work with and plan around natural regeneration that occurs after a wildfire (Halofsky et al., 2018).

Regeneration after wildfires is highly variable across the burned area, influenced by a host of factors: topography, substrate, macroclimate and microclimate, patch size, landscape configuration, and ecological legacies, to name a few (Johnstone et al., 2016; Kemp et al., 2015; 2019; Stevens-Rumann et al., 2018). Ecological legacies can be material - seeds, living trees, dead trees, nutrients - or they can be informational such as species adaptations to disturbance regimes (Johnstone et al., 2016). Some patches across a burned landscape will regenerate quicker than others, though the slower patches are not generally a cause for concern. Early successional habitats created by stand-replacing wildfires often have high species diversity and are important for wildlife (Noss et al., 2006; Swanson et al., 2010). Differing rates of succession across a landscape means that early successional patches will be available across the landscape for many years, or decades, after a fire which can better support diverse wildlife in the long term (Noss et al., 2006; Swanson et al., 2010).

There is a recent trend of declining tree seedling regeneration in the Rocky Mountains after wildfires, especially on dry sites, with increasing unpredictability of post-fire macro and microclimates and farther distances to seed sources in large, burned patches (Kemp et al., 2019;

Stevens-Rumann et al., 2018; 2019). Fires may become even more severe and larger in size (Westerling, 2006). The mortality, or removal, of material legacies from high severity fires or from post-fire management, combined with long distances to seed sources in large, burned areas are other factors that may limit tree regeneration in the coming years (Johnstone et al., 2016; Kemp et al., 2016; Stevens-Rumann et al., 2018). Furthermore, if wildfire frequency continues to increase, or if other compound disturbances occur such as droughts that disrupt informational and material legacies, a transition to a non-forested or different kind of forest could occur (Johnstone et al., 2016; Westerling, 2006). In large patches of high severity where distances are too great for seeds to be dispersed and transitions to non-forested states are undesirable, managers may opt to plant tree species in suitable burned areas to restore forest (Stevens-Rumann & Morgan, 2019). Fire-adapted landscapes typically have a high resilience to wildfire, though global change adds uncertainty to future ecological trajectories (Hessburg et al., 2019; Noss et al., 2004; Stevens-Rumann et al., 2019; Turner, 2010).

The previous sections have traced how park management philosophy and active management such as ecological restoration have changed over time. I have also described key factors to take into consideration when managing post-fire environments, and post-fire impacts that are being seen in Rocky Mountain forests under climate change. A key actor in all of these discussions is of course the manager or practitioner themselves, who not only make decisions about how to manage the landscape but have their own lived experiences in those landscapes.

Human Experience

On top of the challenges in adapting to global change from an organizational perspective, many people are experiencing ecological grief over impacts and losses associated with global

change (Cunsolo & Ellis, 2019; Holland, 2016). People working in parks and protected areas confront loss and trauma through wildlife mortality, human conflict, human mortality, search and rescue operations, and wildfires, among many other incidents (English, 2018). Furthermore, as Holland (2016) suggests, grief can be experienced when losing less tangible things like familiar places or landmarks, beauty, freedom, biodiversity, or our sense of meaning. Holland (2016) writes, "grief at any rate - or more generally, our sense of loss - is the price we pay for meaning" (p.54) and argues that ecological restoration can be seen as a response to the loss of meaning and a way to come to terms with loss. How people experience and perceive change, and the values they hold, play into restoration decision making. Hobbs (2013) reflects on how conservationists may be experiencing grief and a journey in coming to acceptance about inevitable changes to ecosystems that they love. Hobbs (2013) suggests that where conservationists are on the grief spectrum, denial, for example, may make them less willing to accept change and more likely to actively resist it.

There has been an increasing amount of discussion around these human dimensions of restoration in recent years. For example, Freeling & Preston (2019) discuss the merits of adopting a stoic attitude in restoration practice to avoid being paralyzed by grief. A stoic approach would understand what is in one's control and what is not, and focus on the intention behind the process rather than solely the outcome (Freeling & Preston, 2019). Likewise, Pearce (2018) discovered that learning to let go was an experience many volunteers had while participating in ecological restoration. "Through ecological restoration, people are able to learn from the environment about change, acceptance, impermanence and letting go. Emphasis is placed on the practice itself rather than fixed outcomes" (Pearce, 2018, p.186). Pearce (2018) also elucidated that love - for place, people, and non-human nature - was a strong motivator for

participating in ecological restoration. Similarly, young restoration ecologists are affirming that optimism and hope for a better world are part of the very essence of restoration, drawing them to it (Palmer, 2019).

The pressures threatening ecosystems are intensifying, so too are discussions about what it means to be human in the face of such loss and change. One mechanism to record change over time is photography which plays a key role in my research and its role in National Parks specifically is discussed in the next section.

Brief History of Scientific and Survey Photography in National Parks

Photography has played a vital role in depicting parks and protected areas. Photographs, for example, were used to draw in tourists to the newly formed Rocky Mountain Parks such as Banff and Jasper in the late 1800s and 1900s (Cronin, 2011; MacLaren, 1999). Many landscape and wildlife photos used historically in national park advertising controversially portray a majestic wilderness without humans, reinforcing the nature/culture divide and simultaneously erasing the long history of Indigenous peoples living on the land (Cronin, 2011; MacLaren, 1999). MacLaren (1999) writes, “The overarching paradox appears to be that we recognize and value wilderness, at least in the context of national parks, through the images we deploy to invent it; the human defines the non-human” (p.9). Photos in national parks have always been used to fortify the Canadian national identity (Cronin, 2011; Klett, 2004; MacLaren, 1999; Smith, 2014).

Around the same time national parks were starting to form in the late 1800s and early 1900s, the mountain ranges of the Canadian west were being surveyed for the first time by various government departments such as the Geological Survey of Canada using photo-

topographic techniques (McLaren et al., 2005). Photography lent itself well to the challenge of mapping the mountains. Classic ways of surveying using chains, while good for working in the prairies, were not efficient in areas of high altitude (MacLaren, 2005). Additionally, surveying had primarily been used to map out plots of land for new settlers which were cookie cutter rectangles, but the maps that were to be created for the mountains were more about resources and travel routes, and much more dynamic (MacLaren, 2005). Measurements could be derived from photos when the subject area was captured in a triangulated fashion around a known point to create accurate maps of topography (MacLaren, 2005).

Four historical photographic surveys undertaken by four different surveyors occurred between 1909-1915 in WLNP. The most prolific surveyor in Waterton Lakes and across the Canadian Rockies was Morrison Parsons Bridgland who worked for the Dominion Lands Survey (DLS). Arthur O. Wheeler was a renowned surveyor with the DLS, and Bridgland's mentor, who was responsible for the Interprovincial Boundary Survey between Alberta and British Columbia on the western edge of Waterton Lakes in 1915 (MacLaren, 2005). Albert Campbell Termain Sheppard surveyed the Flathead Valley west of Waterton in 1914 which included a few locations in Waterton Lakes, and surveyor W.F Cochrane was a part of the International Boundary Commission that mapped the 49th parallel between Canada and the U.S. in 1909.

The historical photographs in the entire survey collection, which spans the late 1800s to the 1950s, are vast, numbering greater than 120,000 in the eastern slopes of the Rocky Mountains alone. Furthermore, the photographs were taken using similar techniques and in a systematic fashion meaning that, together, they provide coverage of practically the entire Rocky Mountains landscape in exceptional detail (Sanseverino et al., 2016). This is highly useful for answering scientific questions about landscape dynamics when compared with modern repeat

photographs taken from the same location (Sanseverino et al., 2016). The Mountain Legacy Project houses this collection of historical survey photographs.

Repeat photography is the act of retaking a historic photograph from the exact vantage point it was taken from (Klett, 2011). It is a widely applicable scientific method to understand ecological change over century or more time periods by comparing the changes between the two (or more, as in a multiple sequence) photos quantitatively or qualitatively (Webb et al., 2010). Mark Klett (2011) writes, “By eliminating the variable of where two photographs were made in space, the viewer is free instead to contemplate other differences, such as visible changes between the two views” (p.5). The use of historical photographs in this way has the advantage of further temporal depth than most scientific datasets (Webb et al., 2010). There is no limit to the number of times a photograph can be repeated, and this only adds to their enduring value in tracking history over time. Mark Klett wrote about what he calls “third-view” repeat photography work in the American West and reflected on the fact that each photograph in his third-view set was created for a different reason, but “each is linked by common points in space and contributes to an evolving dialogue about change, culture and technology” (Klett et al., 2004, p.2). The methods and applications of repeat photography have been developed and refined over the past several decades by the Mountain Legacy Project and others (Fortin et al., 2018; Klett, 2011; Rhemtulla, 2002; Sanseverino et al., 2016; Stockdale et al., 2019; Trant et al., 2020).

Repeat photography is not new to national parks in Canada or the United States. Repeat photographs are directly intended to depict change such as the encroachment of human presence into national parks and their surroundings over time, and their impacts on ecological integrity (White & Hart, 2007). For example, White & Hart’s (2007) *Lens of time: a repeat photography of landscape change in the Canadian Rockies* shows tourism infrastructure development,

receding glaciers, and forest encroachment over the past century in areas like Jasper and Banff. Rhemtulla et al. (2002) studied forest encroachment in Jasper National Park and pioneered novel methods for quantifying vegetation change from photographs. Recently, Berger (2017) used repeat photography to look at geological changes such as slope failures, landslides, changing position of the shoreline, morphology of streams and sediment loading in Gros Morne National Park, Newfoundland. Repeat photography has been used in the arts (Klett, 2011), notably in Klett, Wolfe, & Solnit's *Yellowstone in Time* (2005) that repeats photographs of iconic sites in the park that were originally taken by artists like Ansel Adams.

In Waterton Lakes alone there are several repeat photographic studies assessing vegetation change over the past century. Cerney et al. (2008) analyzed vegetation change on Bellevue Hill in WLNP and found an increase in conifer tree canopy and aspen in the montane ecozone. These results are similar to MLP alumni Lisa Levesque (2005) who used historical Dominion Land Survey data in combination with repeat photography to determine the extent to which aspen have encroached into the meadows and grasslands of WLNP. Smith (2007; 2014) also explored repeat photography through a visual art and anthropological lens in Waterton Lakes.

To my knowledge only three studies have been published using repeat mountain photographs in a photo-elicitation interview, which is the method I propose to use to answer my questions that I will discuss further in Chapter 3. Jenna Falk (2011), a previous masters student in the MLP, had success in eliciting park manager knowledge on the challenges of managing and restoring remote mountain ecosystems using MLP repeat photographs in focus groups and interviews. Previous MLP masters student Kristen Walsh used the photos in interviews with fire tower lookout observers in Alberta to elicit their experiences of wind and weather (Walsh, 2016).

The other study was carried out by Garrard et al (2012) who argued that it was an effective deployment of the method to elicit local stakeholder knowledge of ecosystem services in a mountainous village in Nepal.

This chapter has set the stage for the presentation of my findings in Chapter four and five through discussing critical background issues that form the foundation of my research project. In Chapter 3, I outline the photo-elicitation methodology used in answering my research questions and describe the fieldwork undertaken in support of this research.

Chapter 3: Methodology

This chapter outlines my methods. For the most part, the methods are the same for each of my two main research questions. I make explicit mention when methods pertain only to my second research question. My methods illuminate the lived experiences and perceptions of the people working in and managing the landscape of Waterton Lakes National Park after the Kenow fire. I approach my research from the constructivist paradigm in qualitative research under the assumption that multiple interpretations of reality exist and are constructed by individuals based on their lived experiences (Creswell, 2013). Three assumptions underpin the constructivist paradigm: knowledge is subjective and co-created by the researcher and participant; the methodological approach of constructivism is aligned with an inductive approach; and the researcher carries their own values, beliefs, and biases into the study, which compels transparency and clarity (Creswell, 2013; Creswell & Creswell, 2018).

I treated my understanding of what I observed within the framework of a case study. Case studies, methods-wise, are well suited for research that is trying to describe and understand a unique, contemporary event, where the researcher can interview participants involved and draw upon multiple sources of data to increase depth of the findings (Creswell, 2013; Yin, 2009). I will be using a variety of methods to enrich my case study: repeat photography; semi-structured interviews using, in part, photographs as talking points (photo-elicitation); reflexive journaling, reports and news articles.

In research using visuals such as photographs, how researchers and participants conceptualize the photographs is itself a methodological consideration. For example, researchers might consider photos as representing accurately what was in front of the camera (realism), or as

pure constructions (the representation of what the photographer saw or imagined), or somewhere in between (Tinkler, 2014). Tinkler (2014) calls this the continuum of realism. The historical survey photos were taken with a scientific purpose, using scientific techniques, to get an accurate depiction of the landscape and be able to map it. Scientific techniques were also used for the repeat photographs, but with a different overall purpose. The photos in this collection show clear evidence of the reality represented in the photographs at the time they were taken (eg. forest encroachment; evidence of fires; old trails, development), thus I consider the photographs to fall on the side of realism in Tinkler's (2014) continuum of realism. At the same time, I consider them to be somewhat constructed because though they were taken for a specific purpose, for mapping, there is much happening on the landscape that may not be evident in the photos. For example, the photos may not show Indigenous or settler presence on the landscape, park boundaries, or fine scale impacts of tourism.

In addition to this, repeat photographs can be perceived to represent linear change over time, when often the reality is much more complex, as von Hellermann (2020) discovered in their ethnography of landscape change using repeat photography in Tanzania. The changes shown in von Hellermann's (2020) photographs often contradicted what locals actually perceived as changes to their environment over time, highlighting the fact that repeat photographs are only snapshots of one moment in time, as all photographs are. von Hellermann (2020) states that there are "many different possible developments in the century that passed between when they were taken, and indeed earlier, and equally many different possibilities in parts of the landscape not captured by the camera" (p.382).

With this in mind, I consider the photos to depict evidence of the reality that was in front of the camera when they were taken, but there are other aspects of reality that maybe aren't as

evident. Similarly, there may have been intermittent changes between time periods that confound the linear change portrayed in the photos. Photo-elicitation, a method that uses photos in interviews as talking points that I will describe in detail in the next sections, is an interpretivist method that can help expand what can be known about the world from looking solely at what is represented in the photos, allowing people to share their own experiences and understanding (Tinkler, 2014). Klett et al. (2005) wrote that repeat photographs “can show change, but they can’t explain history” (p.3).

Data Collection

Photo-elicitation Semi-structured interview

Semi-structured interviews with photo-elicitation were the primary method used in this study, where repeat photography played a central role. Interviewing is a method that is frequently used in the field of conservation and restoration to gain understanding on specific ecological issues and to understand the beliefs and values informing decision making (Young et al., 2018). Semi-structured interviews are more flexible and informal than interviewing people using a standardized set of questions. They are guided by overarching themes or subjects that the interviewer wants to touch on but allows for the interviewees own experiences to not be restrained by a set of questions (Ayres, 2008). Before explaining details about my interview approach, let me touch on the role of photo-elicitation.

Photo-elicitation is a visual method that emerged in the field of anthropology (Collier, 1957; Harper, 2002). Photo-elicitation uses photos in an interview to draw out richer information and create lengthier and less tiresome interviews than interviews using a standard question and answer format (Harper, 2002). Lapenta (2011) outlines the main “theoretical tenets” that

underpin photo-elicitation which were described by the Colliers (1986) in one of the original photo-elicitation studies. Lapenta (2011) explains that photo-elicitation offers the researcher two “informational values” (p.4), their encyclopedic value and their projective value. The encyclopedic value concerns what is portrayed in the photos such as “objects, persons, and physical...circumstances” (p.4), and the projective value is the potential for the photos to draw out deeper, subjective meanings beyond what is realistically portrayed. It is these two values that, as Lapenta (2011) explains, “constitute the intrinsic potential of the photo-elicited interview as a tool to pursue the researchers’ aims to gain enriched knowledge of other people’s lives, opinions, knowledge, and behaviours” (p.4).

There are three underlying assumptions of the photo-elicitation method. First, it is based on the idea that people learned to process visual information before textual information and that photos can access different parts of our brains (Collier, 1957; Harper, 2002). Second, photos create a comfortable bridge between the researcher and the participant because there is something to talk about that makes it feel less like an interrogation - it can allow for rich collaboration between researcher and participant (Lapenta, 2011). Third, photos can decrease power dynamics that are often present in words alone interviews by increasing the participant’s ownership of the research and making them feel more like the expert (Beilin, 2005; Berbés-Blázquez, 2012; Castledon et al., 2008). On this last point, reduction in power dynamics is most often cited in participant-driven elicitation where participants take the photos, and it can be particularly helpful in working with marginalized communities and with children.

Photo-elicitation can be externally driven, where the researcher provides photographs that they have either taken themselves or gathered from existing photos (Baxter et al., 2015; Falk, 2011; Gill et al., 2015; Harper, 2002), or participant driven where the participants take or

gather existing photos (Lapenta, 2011; Loeffler, 2004). There are many more studies using the latter (Beilin, 2005; Kong et al., 2015; Sherren et al., 2012; Van Auken et al., 2010). The former was more common when cameras were more expensive (Harper, 2002) but is still used in studies where photos the researcher took are ranked based on participant preference (Balsdon, 2013; Gill et al., 2015), or in studies using historical repeat photographs (Falk, 2011; Garrard et al., 2012; Walsh et al., 2017). Though there are fewer studies where the researcher provides the photos, there are benefits to this approach in that the focus of the conversation is more structured around what is portrayed in and of interest in the photos; one can contrast participants' responses and perceptions to the same sets of photos (Lapenta, 2011). With this being the case, there are risks in researcher-chosen photographs: the subject matter may not relate to the participant (Harper, 2002; Tinkler, 2014).

Photographs have the potential to open rich dialogue with interview participants, but they are not guaranteed to be successful, and it can be hard to predict which photographs will work at stimulating dialogue. Tinkler (2014) breaks down two issues relevant to what kinds of photos encourage dialogue, first, the relationship the participant has with the photograph and whether it is meaningful to them, and second, whether the content of the photos encourages engagement. For example, even if a participant brings in their own photos from a family collection it does not necessarily guarantee engagement (i.e., they may have forgotten who is in the photograph, or they may not have any personal stories associated with it) (Tinkler, 2014).

In thinking about the content of the photos, Harper (2002) discusses the concept of “breaking the frame” of the participant to have a rich interview. Harper (2002) explained one of his studies where he photographed aspects of the everyday life of farmers to use in interviews with them. However, these photographs did not provide a unique perspective for the farmers.

When Harper (2002) used historical and aerial photos, the farmers he interviewed were much more animated because of the temporal and spatial novelty of the photos. In a similar vein, Tinkler (2014) writes, “[W]hen the interviewee thinks the photo is obvious, they are perhaps less likely to engage – to really look at the picture” (p.6). Taking this into consideration, I anticipated that the historical photos in the Mountain Legacy Project would have a similar effect of “breaking the frame” of the participants. Furthermore, I assumed that the collection would hold enough relevance to the staff working in Waterton: the photographs portray a familiar landscape (Tinkler, 2014).

Photo-elicitation has been used extensively in fields such as ethnography and cultural studies (Clark-Ibañez, 2004; Harper, 2002). More recently it has been used in environmental applications such as land-use planning and policy research to elicit public valuations of urban forests (Ordóñez et al., 2015), evaluate land management practices (Kong et al., 2015), and understand landscape perceptions of farmers (Sherren et al., 2012). It has been used to understand community resource management (Beilin, 2005), public perceptions of climate change in a State Park (Groshong et al., 2018), and community members perceptions of ecosystem services (Berbés-Blázquez, 2012; Garrard et al., 2012). Photo-elicitation was applied in the field of ecological restoration to elicit public values associated with various landscapes in a provincial park in Ontario to guide restoration decision making (Balsdon, 2013). In a similar vein, Groulx et al. (2017) assessed visitor landscape preferences and willingness to return to Athabasca glacier under future climate scenario visualizations; Weber et al., (2019) expanded on the work of Groulx et al. (2019) and assessed visitor perceptions of tourism infrastructure scenarios adapted to the future climate, with either a low or high commitment to ecological integrity.

There are some limitations of this method. It cannot be used with very large groups (Dandy and Van Der Wall, 2011), it can be difficult to capture certain elements in photos such as landscape patchiness, nutrient flows (Berbés-Blázquez, 2012), climate change impacts in areas where it is not so visible (Groshong et al., 2018), or gossip in a community (Castleden, 2008). There could also be issues restricting access of participants to sites they want to photograph (Kong et al., 2015).

Historical and repeat photographic pairs, or photographic sequences (same location, different times) have seldom been used in photo-elicitation. Those who have recognize their effectiveness in connecting with participants and achieving research aims (see Baxter et al., 2015; Garrard et al., 2012; Klett, 2011; Walsh et al., 2017). In the next section I describe the repeat photography process and subsequent photo selection.

Repeat Photography Fieldwork

Photographs from the Mountain Legacy Project (MLP) repeat photography collection were used in the interviews. For some definitional context, a “survey” refers to the name and year of the historical survey, for example, “Bridgland 1914 Waterton Park and Crowsnest Forest Reserve.” Each general location that a surveyor took photographs from in a survey is referred to as a “station” and each station may have one, two, or three “locations” within it depending on whether the surveyor moved around at the site (Figure 3.1). MLP graduate students repeated a majority of the photo stations in WLNP in 2004 (Levesque, 2005). The Mountain Legacy Project was called back to Waterton Lakes to repeat the stations that overlook the Kenow fire, therefore much of the park will be captured in third-view over the next two years. In 2019 while working

under contract with Waterton Lakes National Park, the MLP field crew repeated for a third time twenty-three of the fifty stations in WLNP, two years after the Kenow fire.

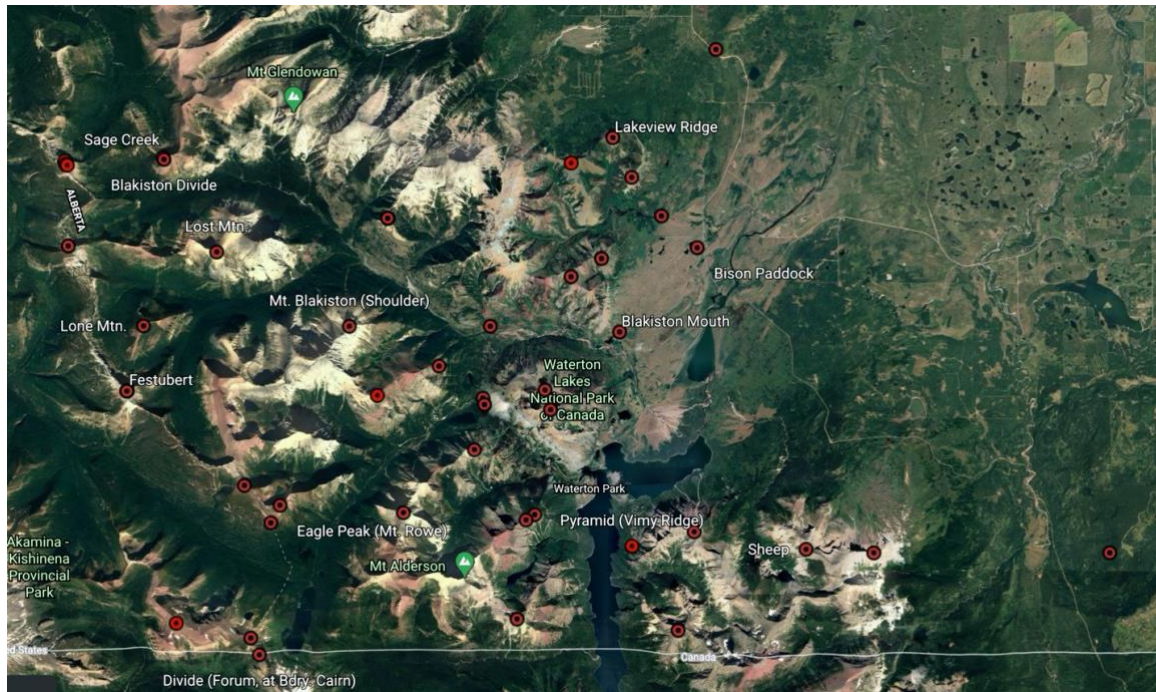


Figure 3.1: Photo stations are indicated by the red dots with a select few stations labelled by name. These photo stations encompass the efforts of four different surveyors: Bridgland (1914), Wheeler (1915), Cochrane (1909), and Sheppard (1914).

Much preparation had to be completed before heading to the field to do repeat photography. To prepare, I first scrutinized the Google Earth map with all stations on it to get to know where they were located relative to one another. The map was prepared by Rob Watt, a volunteer with the MLP and retired park warden. I checked that all stations were in the correct location by comparing what was visible in the photographs to what was visible from that specific peak on Google Earth for due diligence. Once the locations were verified, the historical photos were prepared using Adobe Lightroom (Adobe, 2019). Photo preparation involved resizing,

cropping, and editing to ensure enough landscape features were visible to facilitate finding the location in the field. Preparation also involves placing a grid with crosshairs that indicate the center of the viewshed over top of the photos. The grid helps the field crew line up the photos accurately in the field and to place the camera in the correct location (Falk, 2011; Fortin et al., 2018). Once prepared, all photos were printed and organized in a field binder.

The repeats we took in 2019 are third-views, so for additional guidance in determining the camera location we brought with us printed location photos from the 2004 MLP fieldwork season. Location photos are photos of the tripod/camera location taken by the field crew from three different angles to help subsequent photographers determine where to put the tripod. While it is always best practice to use the historical photo as the reference in repeat photography, location photos from subsequent repeat photography surveys can at least help narrow down the general area where the photo was taken.

At each station, we took repeat photographs, location photos, and completed field notes. Figure 3.1 shows an example of a completed field note sheet.

| | | |
|-----------------------------------|-------------------------------|-------------------|
| HISTORICAL SURVEY: <u>SHEPARD</u> | | YEAR: <u>1913</u> |
| STATION: <u>FESTUBERT</u> | | |
| Repeat Date: <u>JULY 15, 2019</u> | | |
| Start Time: <u>1:20 PM</u> | Finish Time: <u>2:38 PM</u> | |
| Survey Map Sheet: | NTS Map Sheet: | |
| Lat.: <u>49°41'57.83" N</u> | Long.: <u>114°21'55.41" W</u> | |

| | |
|--|----------------------------|
| Hiking Party: <u>ERIC HOGGS, ALEXANDRA SVUNE</u> | |
| <u>JAMES TRICKER, KIMBERLY PEARSON</u> | |
| Pilot: <u>HAMISH</u> | R.W. Call Sign: <u>ETQ</u> |

| | | | |
|----------------------|------------------|--------------------|------------------|
| WEATHER | | | |
| Average Wind Speed: | <u>11.7</u> Km/h | Max. Gust Speed: | <u>24.1</u> Km/h |
| Temperature: | <u>11.8</u> °C | Relative Humidity: | <u>47.4</u> % |
| Barometric Pressure: | <u>752.9</u> hPa | Wet Bulb Reading: | <u>4.8</u> °C |

| | | | |
|-----------------------|---|---------------------|---|
| Location Camera Unit: | <input type="checkbox"/> LCT <input type="checkbox"/> LC2 | Repeat Camera Unit: | <input type="checkbox"/> HB1 <input type="checkbox"/> HB2 |
|-----------------------|---|---------------------|---|

| REPEAT IMAGE DATA | | Card No.: | Internal GPS Active <input type="checkbox"/> |
|-------------------|--------------------|----------------------|--|
| Location | Original Photo no. | Repeat Photo no. | Azimuth: |
| 1 | Plate 4 | <u>3893</u> | <u>121</u> |
| 1 | Plate 5 | <u>3894, 3895 EV</u> | <u>106</u> |
| 1 | Plate 6 | <u>3896, 3897 EV</u> | <u>209</u> |
| 1 | Plate 7 | <u>3898, 3899 EV</u> | <u>243</u> |
| 2 | Plate 8 | <u>3900</u> | <u>293</u> |
| 2 | Plate 9 | <u>3901, 3902 EV</u> | <u>328</u> |
| 2 | Plate 1 | <u>3903, 3904 EV</u> | <u>8</u> |
| 2 | Plate 3 | <u>3905</u> | |
| 2 | Plate 2 | <u>3906</u> | |
| 3 | Plate 1 | <u>3907</u> | |
| 3 | Plate 2 | <u>3908, 3909 EV</u> | |
| 3 | Plate 3 | <u>3910</u> | |
| 3 | Plate 4 | <u>3911</u> | |


STATION NARRATIVE:

We got dropped off by helicopter just after noon. It took a while to locate the Shepard location, and ultimately we decided it was two different locations. One on the east side of the cairn and one on the west. It's amazing to see how the Kennel fire moved through the landscape, and the areas that didn't burn, miraculously. Kim is telling us a lot about her experience - it's quite sad hearing about all the wildlife getting trapped and dying. There isn't a lot of regeneration in the basin below us - I wonder what the reason is? Perhaps elevation, moisture, or solar insulation? In any event, it's inspiring being up here.

THINGS GOT MIXED UP HERE. WE MOVED AND LOST TRACK OF AZIMUTH. UNSURE OF EXACT LOCATION OF SHEPARD STATIONS.

ELEVATION: 2525 m

NOT SO ALIGNED...



7/15/2019

Figure 3.2: Completed field notes for Shepard’s 1913 station on Festubert Mountain in WLNP. Field notes include original photo numbers; file numbers for all repeat photographs; the azimuth of each vantage point; a station narrative; weather data; an illustration; and information about the location and the crew.

We reached the majority of photo stations on foot. The best approach to each station was determined by looking at park maps and consulting with Parks Canada scientist Kimberley Pearson and Rob Watt. For the most part we were on defined park trails except for Bridgland and Wheeler’s “Anderson” station which was a few hundred-meter scramble up from the parking lot at the end of Red Rock Parkway. Our crew made use of the backcountry Snowshoe Cabin for two nights which enabled us easier access to the Avion Ridge and Sage Creek stations in the far

western region of the park (Figure 3.3). With the support of Parks Canada we were able to have helicopter assistance for one field day which enabled our two crews to complete 8 stations.



Figure 3.3: The Snowshoe Cabin is an old warden cabin tucked in the western region of the park up the Blakiston Valley (Photo: Sonia Voiscescu).

The repeat photographs were mostly taken with a Fuji GFX50S camera (28-72mm lens), though some were taken with our second camera, a Nikon D850 (24-70 mm lens). The photos were taken in RAW file format. Immediately after returning from the day's fieldwork activities, the repeat photographs were saved onto three separate hard drives for safe storage. Upon completion of the fieldwork season the photos were uploaded to the MLP online database and made freely available to the public (explore.mountainlegacy.com). These "third-view" sets were the photos I sampled from in choosing the photos I would use for photo-elicitation.

Photo Selection

I chose a subset of 7 third-view photo sets to use in the interviews for a total of 21 photos (Appendix D). Most photos I used were from Bridgland's 1914 survey with the exception of Mt. Festubert which was taken by Arthur Wheeler in 1915. Criteria guiding photo selection was as follows:

1. must be in focus with adequate lighting and minimal shadows;
2. must be a third view (1914, 2004, 2019);
3. both burned and unburned parts of the park are represented;
4. each of the four natural subregions is covered in at least one photo;
5. at least one photo will be taken from a lower elevation (i.e. a valley bottom rather than a mountain top);
6. at least one photo will have anthropogenic features;
7. at least one photo will show an area that has practically no vegetation growing after the fire.

These criteria ensure photo quality, and provide variability in the photo subject matter for participants. This is an important consideration in the choice of photos. Pauwels (2015) offers that, "Visual materials can disrupt or distort the research process by being irrelevant to the issue studied, by being ill-adapted to the respondent or by creating an all too suggestive, one-sided or incomplete picture of the phenomenon or event considered," (p.98). I followed this advice. For example, the foothills parkland ecoregion may elicit rich dialogue for one person but for another person perhaps the subalpine will have stronger resonance if their work is situated there. Similarly, some participants may have never been to the top of Festubert Mountain, or perhaps even any of the mountain peaks, therefore a lower elevation picture may be more relatable.

Having anthropogenic features in the photos will make visible the human influence on the landscape because that is a truthful representation of the landscape. I wanted the photos to have adequate lighting and minimal shadows because a change in lighting from photo to photo may encourage the participant to focus on that rather than other differences in the photos; it can be a similar distraction as if each photo was taken from a different vantage point (Klett, 2011).

After selecting the photos I aligned them using the Image Analysis Toolkit (IAT), custom software developed by the MLP (Sanseverino et al., 2016). Aligning the photos allows accurate pixel-mapped overlays for quantitative evaluations of landscape change (Sanseverino et al., 2016). If photos are not aligned, participants may be more likely to focus on that rather than actual changes in the landscape (Klett, 2011). Once aligned, the photos were edited using Adobe Lightroom and Photoshop to prepare them for printing.

Considerations for Presentation of Photos

Photos can be presented to participants in a variety of sizes and formats, including digital and hard copy. If they are hard copy, allowing people to physically engage with them or “play” with them by writing or drawing on them can add to the sensory experience (Tinkler, 2014). If they are digital, special software can allow for an interactive experience, such as the Time Reveal Window that Klett (2011) used in his Third-View project. This is a floating window that reveals the historic photo underneath the contemporary, or vice versa. The MLP has a tool like this in the Image Analysis Toolkit (Sanseverino, 2016) and in MLP’s explorer app (explore.mountainlegacy.ca; for aligned images). Klett (2011) experimented with what he called “embedded rephotographs,” where photos taken from the same vantage point, or different vantage points close by could be merged into a larger photograph that gives the viewer an

expanded sense of the space. Baxter (2015) similarly experimented with embedding historical photos into contemporary photos in their study eliciting the cultural importance of a main street in Scotland (Baxter et al., 2015; Klett, 2011).

After considering these and other options for presenting the photographs, I chose to print the photos to encourage physical engagement with them (Falk, 2011; Tinkler, 2014). Prints were 16.5” x 23.4” so they would be large enough for landscape features to be easily visible. Prints were laminated to allow participants to use dry-erase markers and annotate them if desired, which might enhance the sensory experience (Falk, 2011; Tinkler, 2014).

Interviews

Before commencing participant recruitment and conducting interviews I obtained ethics approval from the University of Victoria (Appendix C; Protocol Number: 19-0410-02) to conduct my research. Participants were recruited, and interview times were organized, by my primary contact in WLNP, Kimberley Pearson. I used the snowball sample method to recruit one person, as they weren’t currently working in WLNP. My research questions centred on landscape change and management decision making, therefore my selection criteria for participants were that they were resource conservation staff whose work involves being out in the landscape, monitoring and doing ecological restoration activities. Ideally, they worked in the park before and after the fire so could better comment on their experiences with the fire itself and its aftermath, though not all met this criteria. Some participants that were not part of the resource conservation unit and were added to the study to provide other perspectives on how the fire influenced the park. All participants recruited agreed to participate. An initial invitation letter (Appendix A) and consent form including a project description (Appendix B) was emailed to all

participants before the interview and the consent form was signed before commencing the interview. Interviews were held in the Waterton Lakes National Park office from March 1st to 14th, 2020, with the exception of one interview that was over the phone, one at a participant's house, and one that was in Calgary. 14 interviews were held ranging in length from 1 to 3 hours, with an average of 1 hour and 20 minutes. I held one follow up interview with a participant that was 40 minutes long.

After initial introductions with the participant, and letting them know my background and interest in ecological restoration, photos sets were cycled through one by one and time and space were given to participants to comment on anything that stood out to them. I chose which sets to bring out. I tended to start with photos from Festubert Mountain where the fire entered the park, and work my way east through the park, though there was some variation in this from participant to participant. Pre-determined, open-ended interview questions that would elicit a narrative response rather than a yes/no answer were used to stimulate conversation where appropriate (Appendix E). Interviews were semi-structured so not all questions were asked of each participant and questions were not asked in any particular order (Ayres, 2008). Before each interview I reflected on my questions to think about ones that were critical to ask that particular person based on their expertise. Questions revolved around landscape and climate change, ecological restoration and park management concepts, impacts of the fire, and personal experiences. Interviews were recorded using a ZoomH4N recording device. Immediately after each interview recordings were backed up on an external hard-drive and an Apple MacBook Pro laptop computer.

After each interview I wrote my immediate reflections in my journal about how I thought the interview went, anything that needed to be adjusted, and anything that stood out to me. For

example, after the first two interviews I reflected on how the method was working and determined that I needed to refrain from asking my interview questions until enough time and space was given to the participant to look at and reflect upon the photos themselves. In the first two interviews I asked questions while changing the photograph sets which seemed to take attention away from the photos and put it solely on the question. Tinkler (2014) suggests that the time that photos are introduced in the interviews must be predesigned. If photos are present throughout the whole interview that might overemphasize what is going on in them. In contrast, if they are introduced after some time has passed, participants may be inclined to use the photos to confirm things they said in the talk-alone interview (Tinkler, 2014).

In the evening I wrote reflections of what I was seeing and experiencing. These reflections, along with my post interview reflections, altered the design of the interviews in one way. I had laminated the photos so that people would be able to draw on them with white erase markers. However, I had made an error and forgot to offer the white erase markers in my first interview, and then in subsequent interviews I had shown participants the markers and told them they could draw on the photos, but nobody used them. This led me to not have data in the form of annotated photographs. I ultimately was fine with this because I wasn't certain about what I would use that data for after reflecting on it. Falk (2011) felt that annotating photos in focus groups was a good way for participants to collaborate and illustrate their points when discussing a photo, but ultimately Falk (2011) did not find that data particularly helpful in her analysis. I thought it could encourage physical engagement with the photos and be an interactive experience, but it didn't work out that way. Perhaps if I would have modelled using the markers on the photos, participants would have registered that they could do that.

After the first 4 interviews I wrote out my research questions to reflect on whether I felt like I was on the right track. I wrote that I should potentially add another research question: “can the experience with the Kenow fire shed light on where PC [Parks Canada] is heading in the coming decades?” In going back to my journal and reading that, it is clear based on the conversations I was having that I was starting to think more broadly about the importance of Waterton’s experience in the big picture of Parks Canada, and what can be learned there to feed into how that organization is adapting to global change. In the end this didn’t influence the design of my study and I did not make it a research question because I did not want to generalize to such a degree.

Relating to this journal reflection, I was reflecting on the participants views on novel ecosystems, and I wondered about how their views might be helpful to the Parks Canada Agency in policy adaptation. I had one question on novel ecosystems, which I often phrased as “novel ecosystems, or ecological novelty...”. These are not equal concepts, as I outlined in Chapter 2, and looking back on my transcripts I should have clarified the difference for participants. Nonetheless, the conversation around this topic was intriguing, as I will discuss in the following chapter, therefore I spent much more space and time writing about this than I anticipated in setting out in this research.

Data Interpretation

Coding and Interpretation

Interview recordings were transferred by digital memory card to an Apple Macbook Pro laptop computer and initially transcribed using the Otter.ai automated text transcription software, and then they were manually adjusted for accuracy in Microsoft Word. Full transcriptions were

then uploaded into the Computer Assisted Qualitative Data Analysis Software (CAQDAS) program ATLAS.ti (ATLAS.ti Scientific Software Development GmbH, 2019) to be coded. Coding and memo writing are part of the data interpretation process of qualitative researchers. Coding is a process of “working with your data and determining what is important to you and what you have to let go” (Mayan, 2009, p.89). An inductive approach to coding was followed, using multiple rounds of coding to refine the code list and identify major themes (Elliot, 2018; Friese, 2020).

In the first round of coding where my goal was to create an initial coding framework that could be used to code subsequent interviews, I chose a few interviews that were different from each other to capture potential variation in themes. I coded all the interviews once in this round. After this first round, I refined and organized the framework. This was followed by moving through all the broader codes that I had “lumped” many quotations into, reading the quotes one by one, jotting down potential sub codes, and then splitting the codes (Elliot, 2018; Friese, 2020). I used the revised framework to go through all the transcripts again, coding anything that was missed in the first round, and to reflect the nuance that was drawn out through splitting up the lumped codes. This resulted in 104 codes organized into 14 categories (Appendix F).

To help answer my second research question, I coded the transcripts with 14 codes for photo-elicitation (Table 3.1). Specifically, to try and determine the broader themes, and specific issues, that third-view repeat photography can elicit around ecological restoration and park management I used the code co-occurrence analysis tool in ATLAS.ti. This tool allowed me to explore what codes co-occurred (overlapped) with the photo-elicitation codes for each photo time period (1914, 2004, 2019; Appendix F). This analysis tool enabled me to see what themes

people talked about in relation to each photo year and while looking at the photo set as a whole. As I mentioned, I included one code for each photo year (1914, 2004, 2019) such that code segments of text could relate to specific photos. Sometimes these codes overlapped, for example if a participant went from speaking about the historic to the modern, and back again. For the most part it was easy to tell what photo a participant was talking about. Throughout the interviews I would also comment on the photos in such a way that made it clear what photo we were looking at. On occasion it was not clear what time period they were commenting on, so I coded all three years. Other codes that I created specifically to help answer my second research question are outlined in Table 3.1.

Table 3.1: Photo-elicitation codes used in ATLAS.ti, and their definitions

| Code | Definition |
|--|---|
| Photo-elicitation: 1914 | Comments about historic photos |
| Photo-elicitation: 2004 | Comments about 2004 photos |
| Photo-elicitation: 2019 | Comments about 2019 photos |
| Photo-elicitation: experience - orienting themselves | Comments about how they are experiencing viewing the photos, orienting themselves (using map in the room) |
| Photo-elicitation: experience: awkward/unsure | Comments about how they are experiencing viewing the photos, awkwardness |
| Photo-elicitation: experience: enjoyment | Comments about how they are experiencing viewing the photos, enjoyment of the process |
| Photo-elicitation: experience: noticing something | Comments about how they are experiencing viewing the photos, noticing something new |
| Photo-elicitation: experience: relating to photos | Comments about how they are experiencing viewing the photos, relating to the photos |
| Photo-elicitation: photo appearance | Comments about how things are rendered in the photos, scratches, colours, size, appearance |
| Photo-elicitation: lack of change | Every time someone comments on how things have not changed much |
| Photo-elicitation: missing | Things that are missing or not represented in the photos |

| | |
|---------------------------------------|---|
| Photo-elicitation: other snapshots | This will be all references to other photos, things outside the frame |
| Photo-elicitation: personal narrative | Any personal story arising from viewing the photos |
| Photo-elicitation: value of photos | Participant's perceptions of value of photos |

Reflective memos were written throughout the coding and interpretation process so I could look back at all my coding decisions and organize my emerging thoughts while getting to know the data (Friese, 2008; Mayan, 2009). I had several categories of memos: coding, reflection, interpretation, participant, to-do, and thesis. For example, I created a memo called “Interpretation: Q1a” that included all my interpretations and reflections about what participants said about research question 1a. This was a more efficient memo writing strategy than creating a memo for each participant (Friese, 2008).

Research gaps

Visual anthropologist Luc Pauwels (2015) offered a critical assessment of participatory visual methods including photo-elicitation in ethnography, and outlined several recommendations for further inquiry. He suggests research could look at several factors, including: the effects of whether photos come from researcher or participant; the potential of different media such as paintings or film; how photos are presented in terms of how they are framed (whether they are black and white or colour, are on paper or projected); and the influence of different interview settings. Furthermore, he suggested assessing the impact of “using a coherent set of pictures or a mixture of photos from different eras, cultures and segments of society (or historic and contemporary material, colour and black-and-white pictures, ads and

family pictures)” (p.115). This last point is a gap I hope to shed light on in using MLP photography in photo-elicitation and assessing its effectiveness for use in studies of this kind.

Data Considerations and Validity

Much has been written about criteria used to evaluate the validity, or trustworthiness, of qualitative research and whether to use the term validity at all: it is typically used in quantitative research, which has different ontological and epistemological assumptions (Whittemore et al., 2011). Whittemore et al. (2001) synthesized the debates on validity and argued it is a perfectly acceptable term to use when assessing the rigor of qualitative research, concluding that “Qualitative inquiry is equally as concerned about unsound or unjustified findings as quantitative inquiry. The difference lies in the standards of validity that must be upheld within the infinitely different types of inquiry” (p.527). There are multiple techniques or procedures that can be used to ensure validity, reflecting the diverse approaches and emergent properties of qualitative research (Creswell & Miller, 2010; Whittemore et al., 2001).

In the constructivism paradigm where multiple constructions of reality are possible, searching for and describing disconfirming, or contradictory, evidence across all the participant’s perspectives is one way to enhance validity of the findings. This shows you have put effort into managing bias and representing all perspectives if that variation exists in the data (Creswell & Miller, 2010; Whittemore et al., 2001). Integrity is shown when researchers consider multiple data sources and multiple interpretations of the phenomenon by participants, and not just a singular perspective (Whittemore et al., 2001). Through interviewing, transcribing, and interpreting my data, I developed a deep familiarity with it, searching for contradictions amongst

participants. I reviewed written notes from my reflective journal to see if there was anything I may have missed when looking at the transcriptions in ATLAS.ti. Furthermore, I strived to present my findings in rich detail and “thick description” as a technique of ensuring validity (Creswell & Miller, 2010; Whitemore et al., 2001). I used ample direct evidence in the form of verbatim quotes to allow the reader to understand and follow my interpretation of the data (Creswell & Miller, 2010; Whitemore et al., 2001). My aim always is to represent people and their perceptions accurately, which involved returning often to my data to check my interpretations (Creswell & Miller, 2010).

Data Saturation

Data saturation is a point at which no new themes, codes, or data emerge, and at which you can replicate the study (Fusch & Ness, 2015; Guest et al., 2006). Identifying data saturation supports thoroughness in the research and enhances validity (Whitemore et al., 2001). There are many suggestions on how many interviews to conduct in a given research design. However, there is no clear prescription for how many interviews to conduct in a study to reach data saturation or how to determine when it is reached (Baker & Edwards, 2012; Guest et al., 2006; Fusch & Ness, 2015; Mason, 2010). While not a universal solution, Guest et al. (2006) was one of few researchers who analyzed their interview data to determine data saturation, finding that most of the codes they used for 60 interviews emerged after the first 6 interviews, and all of them after 12 interviews.

Rather than focusing on data saturation, some say it is helpful to instead consider when the new data emerging are counterproductive in terms of answering one’s research question, because there will always be new data or codes emerging as you dive deeper (Strauss & Corbin, 1998, as cited by Mason, 2010). Fusch & Ness (2015) offer that having datum that are both thick

in quantity and rich in quality can be helpful; one can have many interviews that do not necessarily provide sufficient richness, and vice versa. Still, there is no prescription on how many interviews are necessary (Fusch & Ness, 2015). Asking the same questions to multiple people is one way to help you reach data saturation (Fusch & Ness, 2015). While the semi-structured format means some questions are not asked of some people, each question in my study was asked of multiple different participants. As I moved through the transcripts in the first round of coding, fewer and fewer codes were created with only one or two new codes being created in the last interviews I went through. In some later interviews no new codes were created which was when I felt as though saturation was achieved (Frieze, 2016).

Another criterion important to ensuring validity involves a researcher being reflexive and questioning such things as their assumptions and biases relating to the nature of being and of knowledge (ontology and epistemology), their chosen methods, motivations for research, potential conflicting power roles, whose voices are being represented and how, and the ways in which they evaluate their data (Corlett & Mavin, 2018; Creswell & Miller, 2010; Whittemore et al., 2001). Stating one's position in relation to the research is important; researchers are often deeply embedded in the research and the knowledge produced (Corlett & Mavin, 2018).

Researcher Position

My work sits on the periphery of a larger research project undertaken by members of my research group at the University of Victoria investigating the emergence of ecological novelty in mountain ecosystems in Canada. My background is in ecological restoration and I have been involved in many discussions about ecological novelty in recent years and have followed this development in restoration closely. Therefore, I come from the assumption that all landscapes

may eventually have novel elements (composition and processes), and that this will be something with which all land management organizations practicing ecological restoration will eventually contend. I am on my own journey of coming to terms with what that means and what parts of that I can accept. Furthermore, as a young person experiencing ecological grief, I am interested in understanding other people's emotional connections to landscapes and how they are impacted by rapid, sometimes devastating change. My position relating to ecological novelty and ecological grief influenced some of the interview questions I chose, and the type of knowledge produced in this work (Corlett & Mavin, 2018).

Chapter 4: The Kenow Fire and its Implications for Park Management

This chapter is the first of two chapters examining the findings of my work. In the present chapter, I have organized my findings under 4 major categories that contribute to answering my first research question that asks: in what ways are people who are involved in managing WLNP's ecosystems experiencing the effects of the Kenow fire, and in what ways does their experience combined with the severity and extent of the Kenow fire influence park management and ecological restoration objectives in Waterton Lakes National Park? The four categories of findings are as follows: 1) characterizing the Kenow fire in the words and experiences of the participants; 2) describing the management approach guiding WLNP; 3) outlining participants' thoughts about the past and future of restoration including the role of history and climate change; and 4) illuminating criticisms participants had about Parks Canada's response to the aftermath of the Kenow fire. In chapter 5, I extend these findings to discuss how the participants engaged with the imagery itself, and the specific issues and themes that arose around the repeat photographs. Throughout participants are numbered (e.g., P7) but will remain anonymous.

Findings

1.0 Characterizing the Fire

"Given today's relatively old and more-uniform forest mosaic, the large pine beetle epidemic, and recurrent droughts, major stand replacement burning may be imminent for WLNP" (Steve Barrett, Fire history of WLNP, 1996).

“Wildland fire presents a prime opportunity to recalibrate the setting on humility and confidence. What are our actual powers? Where does confidence cross into hubris? And if humility needed more to recommend it, global climate change presents precisely that recommendation. Even as we explore the prospect of restoring natural fire to the West’s forests, a changing climate makes it impossible to recapture the circumstances of the past, leaving the concept of restoration floating free of an identifiable baseline, an original state to recapture and recreate. If there is anything left to the notion of the forests as a great laboratory, then climate change has made them a laboratory where someone keeps fiddling with the thermostat” (Limerick, 2008, pp.45-46, as cited by Cole et al., 2010).

“It was literally like entire mountains on fire at once” (P7).

The Kenow fire was a significant event ecologically and also in the lived experiences of people living and working in the area. It is essential first to characterize the Kenow fire in the words of the participants. This was the first time in Parks Canada’s history that an entire park and townsite were evacuated. A few days after the fire started in BC, a participant commented that “the sky turned green and there was ash falling” (P7) which was the beginning of a realization that this fire may turn into something big and enter the park. The park had a week to get organized and prepare as the fire “boiled around” (P7) on the west side of the continental divide in BC. During that week the park focused on suppressing a spot fire near the divide to stop it from coming over into the park, and it is likely that the fire would have jumped over sooner than it did had these measures not been taken. If the fire would have come over earlier, a participant said “it would have taken a run at Lethbridge or as far as it could run across the prairies” (P2) rather than stopping just outside the park boundary when the wind finally turned back on itself.

It was the third driest year in recorded history and there were fires happening all over BC and Alberta. In fact, the Verdant Creek wildfire in British Columbia’s Kootenay National

Park burned a similar amount of area (just over 18,000 hectares) around the same time in 2017 (Parks Canada Agency, 2019d). The Kenow fire burned in the early fall under extreme wind conditions. One participant remarked, “A fire in those conditions, you don't put them out. It doesn't happen. You trade space for time” (P8). The Kenow fire burned from “ridge-top to ridge-top” (P13), up both the Red Rock and Akamina valleys at the same time. The fire crews were taken off guard as they had only been focusing on the Akamina valley that led to the townsite. This meant that the last employees evacuating the park drove out with fire on both sides of the highway. Despite how close the fire came to burning the townsite (Figure 4.3; see figures 4.1 and 4.2 for historical and 2004 repeat photos), it was largely unscathed. A participant comments:

“We really dodged a bullet. And...there was a reason we dodged a bullet there...as part of the fire management program and wildfire risk reduction we've been actively taking efforts to protect our communities by creating fire guards, and things like that...over the past 10 years” (P13).

Despite the town being unscathed, some infrastructure was destroyed in the fire including the Crandell Campground, new Visitor Centre, Alpine Stables, and some staff accommodation (Parks Canada Agency, 2019a).



Figure 4.1: Bridgland's 1914 Cameron Bend Station #111, some infrastructure can be seen in the future site of the town (Photo #: 740).



Figure 4.2: Repeat from 2004 shows the expansion of the town over the past century in the lower left portion of the photo (Date: 08/10/2004, Photo #: B0013P0048).



Figure 4.3: A view from Bridgland’s 1914 Station #111, Cameron Bend, looking down at Waterton Townsite to the east. This photo shows how close the Kenow fire burned to the town (in the bottom left). (Date: 07/15/2019, Photo #: DSC_6814).

Most people understood a large fire would likely happen eventually because fire is a natural process in the park and there was plenty of fuel available, “Kenow could have happened dozens of times” (P11). Though one participant reflected, “I don't think a lot of people ever foresaw a fire quite like this because it.... redefined a lot of things about fire behaviour...with the speed that it moved at and the uniform severity of it, and that it happened at night” (P7). Another surprise for the fire crews was that aspen stands, which are normally considered a fire break when they are green, were burned severely: “I’ve never seen a fire move through aspen the way this fire moved through aspen” (P11). A fire break was bulldozed around the northern boundary of the park that abuts private ranch lands and fire retardant was used to help stop the fire’s

spread. While looking at the photo from Lakeview Ridge (Figure 4.12) that shows the area where these actions occurred, a participant explained that bulldozing and fire retardant “is something that doesn’t...happen...very easily in National Parks” (P7). I was told it was an “unprecedented control effort for a national park to pull those measures out in an effort just to make sure that it didn’t move any further” (P7).

Participants’ experience of the Kenow fire while it was burning and in the aftermath was suffused with mixed emotions. One participant explains feelings they and other staff felt:

“For the first year after as we went back to these places for the first time, and there's still places to go back to for the first time, it's kind of stunning ... it's emotional, or it can be, and it takes a bit of energy to, to just put to that...a bit of a grieving for... the landscape that you knew. But of course, ... I'm always positive about it...that's just the way it is, it's something we can't change, but it... still kind of grabs you a bit” (P7).

Mixed feelings of grief over loss, and excitement over the opportunity to learn were felt by many. In one case, a participant said: “I was worried about... the human side of it, but I never once...really worried about the park” (P5), reflecting on their fears over the community and staff’s safety during the event. Some participants lived close to the park, one of which describes their anxiety as the fire moved closer, “I eventually...went home and packed up more of...our stuff and thought okay, this is actually...happening, we may lose our house tonight” (P7). One participant was surprised at the depth of emotional response they felt in witnessing the changed landscape because they didn’t consider themselves an emotional person, jokingly explaining their belief why - “I’m a scientist, it’s terrible” (P1). They understood that fire was an important natural process and were excited at the opportunity to learn. They said:

“From an ecological perspective, it's fascinating, so many neat things to see, so much to learn.... I think a lot of us rallied behind that, lots to get done, you

don't want to miss that opportunity. And [there was a lot] of work... projects and partnerships ...to put in place... that kept us all busy. And I think that's really, really cool. So from a rational perspective, really, really interesting....From the emotional perspective...I was really surprised how impacted I was by just physically seeing what you know, is ecological renewal or whatever you want to call it, but it's ugly and devastating” (P1).

They reflected on their decision to leave and work at a different park: “I think, one of the reasons I left was because of the fire, quite frankly.... I was there for many years. I don't like the post fire landscape and I'm happier not being there and seeing it” (P1). Another participant articulates their mixed feelings:

“I've been more excited by the change in the landscape and interested by it. Sometimes..., in the winter especially, in a burnt forest I miss like the color of the evergreens..., it is nice...to be in a live forest at times, it's more calming I guess. Especially with the wind and the dead trees and stuff it can be a harsher landscape” (P4).

Being physically in a landscape that a participant knew as existing one way that suddenly underwent transformation so rapidly was described as disorienting:

“A couple of times last summer I was walking on trails ... that used to be ... heavily forested..., and I never felt this before.... I felt vertigo as I was walking down these trails...you're on the mountain and you've got a solid space here but then it drops away and there's nothing but burnt trees...and it's not blocking your view, so I got really dizzy.... definitely disorienting.” (P7)

A couple participants did not experience many emotions around the fire, but were excited to learn from it:

“It was really interesting....it's just kind of cool to see how the landscape changes after such an event. So it wasn't...with any negative or positive feelings. It was just like, okay, there's a big change event. Let's see what's happening” (P9).

The emotional toll was significant for many, and the rapidly transformed landscape also increased staff workloads two or threefold overnight which created a lot of stress and in one department's case, staff turnover.

“There was certainly a stress on the people in the office and on the management team. It wasn't related to the fact that the fire had come through, we all sort of intellectually understood that it's a natural process...[P]eople were out of their homes. We had moved the entire office structure. People...weren't doing their regular jobs during the fire, they were reporting to people who [they] didn't normally report to you. They were sleeping in hotels. ...[W]e were working 12 or 14 hours a day, every day for...weeks at a time, and it was just hugely stressful.” (P2)

Another participant said they had no doubt the landscape would be resilient, but that they “totally underestimated the effect on...the workplace community” (P5). To help cope with the stress there was a lot of support shared among staff across departments, and there were Critical Incident Debriefs undertaken to address the emotional and psychological needs of staff right after the event.

The amount of research happening in the park in collaboration with universities has increased, a participant stated “We're partnering more closely with universities...There's just more research now than there was pre-fire” (P14). Another participant highlighted the importance of collaboration with other jurisdictions and organizations, before and after the fire, saying:

“There was an amazing complexity of organizations that were involved in the management of the fire itself... [It's the] same with...the post fire world and landscape, we couldn't and shouldn't work in isolation...we need to work in partnership with people...that's where things...really start happening” (P7).

There was substantial archaeological work being done immediately after the fire to take advantage of the fact that over half a metre of topsoil was removed in some places. The

archaeology team were finding things like blue trade beads and arrowheads which generated a lot of excitement and media coverage, uplifting people's spirits.

"The one thing about archaeology is that people are interested in it because... it's old. And so along with the excited archaeologist comes...media interest and then pretty soon they've got the TV cameras...following us around and then it hits the national news and all this stuff. And so... this momentum of good news comes through the park, and then suddenly people are starting to [say], hey, you know, this is great because...all they [have] dealt with...to that point was just disaster, just dealing with the aftermath of a disaster. So ...it was kind of fun that way, but it was it was kind of surreal" (P3).

Another source of happiness for people in the aftermath of Kenow was the sight of wildflowers on the prairie (Figure 4.4), which was reported as an energizing force for healing and resilience. In seeing fireweed (*Chamaenerion angustifolium*) in particular, a participant reflects:

"I remember being really happy when I would drive in..., after...seeing the park in between fall of 2017 when the fire happened.... Up until that point, it looked like the parkways were just completely blackened...they looked...for lack of a better word, they looked dead. But they weren't.... Within a few months after that it was like just a whole field of purple up on the side of a mountain" (P6).



Figure 4.4: 2019 repeat from Bridgland’s Blakiston Mouth Station #98 that captures the display of wildflowers (07/11/2019, Photo #: DSC_6737).

Wildflower bingo was an activity that people participated in to document and celebrate the emergence of plant species each year (Figure 4.5). Participants would get points for checking species off a list once they found them in the field, and then post photos to the wall in the main office building for others to see.



Figure 4.5: Photos on the wall of the Waterton office from participants of wildflower bingo (Photo: Cassandra Buunk, 03/11/2020).

Wide-ranging emotions were felt by staff during and after the fire. Sadness and grief over loss, stress from heavy workloads, happiness witnessing plants and animals coming back, and excitement over the opportunity to learn. The next section outlines the general management approach that WLNP took after the Kenow fire.

2.0 Management Approach after Kenow Fire

Initially feeling worried about what vegetation would come back after such a severe event, the park convened with experts in 2018 to receive feedback on what they should expect to see happen in coming years, whether or not to be worried, and what essential monitoring data

had to be collected right away to be able to support long term research endeavours. The experts, who were ecologists in diverse areas (aquatic, fire, vegetation), said the landscape would be resilient and there was no cause for concern. According to one participant, the experts advised,

“Don't be in a rush to come back and do a vegetation inventory, let things settle down for at least five years [to] go through some successional stages. We've already seen successional stages with lamb's quarters in the first year that was really, really prevalent and then much less prevalent in the ... subsequent year.... We had...full fields of glacier lilies in some places under the trees, which then weren't there the next year....It'll take about five years to see if you've got trees coming back” (P2).

Thus, WLNP was in a “wait and see” (P11) mentality at the time of interviewing, observing *renewal* in action. The word renewal was chosen as the way to talk about how Waterton’s ecosystems are responding and growing back after the Kenow fire (Figure 4.6): “We use the word renewal because it's sort of more open ended...it'll be whatever it is” (P7). The word renewal is used to manage the public’s expectations and perceptions around what is happening. One participant said it was gratifying to hear a member of the public using the word renewal themselves, suggesting that public outreach was taking hold and people were understanding the landscape might look different than what they were accustomed to. The park had received many inquiries from the public on what their plans were for the burned area, and whether they would do any fertilizing, salvage logging, tree planting, or seeding. A participant commented on the difficulty of doing these activities on a park scale and the approach they are taking instead:

“Can you imagine the scale of that, number one, number two,...we just let nature take its course...and nature is doing its job, right....It's re-vegetating as appropriate for this climate” (P7).



Figure 4.6: Similar to wildflower bingo there is a wall of photos documenting life coming back on the landscape, and interesting findings such as squirrel seed caches and bison skulls (Photo: Cassandra Buunk, 03/11/2020)

Another participant worries about the impacts of large-scale restoration efforts in a post-fire setting:

“I think there's been lots of failed experiments ...trying to do restoration post-fire in the US.... They've... tried to get some growth and I think they end up with...big fields of invasive plants” (P9).

Upon coding the interview transcripts, an emerging category was “Management Approach” (Appendix F) which coded instances of participants commenting on management approaches taken in the park, before or after the Kenow fire, or in past management. Within this category there were codes such as active management, passive management (let it be), science-based management, balancing dual priorities, and fire suppression. Both the active and passive management codes had the same number of quotations attributed to them, twenty-two.

The park's general management approach in the burned areas is to let "nature take its course" (P1; P7) which was coded as passive management. I was told by participants that there is no specific goal for the ecological trajectory of the burned area, as one participant explains, "We don't have a target for this. We just want to see what happens" (P2). Another participant remarked:

"There's just so many unanswered questions that in my opinion, you're best off to just let nature figure out ...what the next stage is and let things adapt ...It's a hard decision because some things won't adapt, and they will be lost. But I think at the scale that we're looking at, it doesn't make sense to do anything else other than the things that we know are stressors that are human caused...introduced things...and we should try and make sure those additional stresses are controlled" (P1).

In describing their park management approach, that same participant commented: "If there's something that looks way out of whack... then then maybe we look into it, but for the most part, we're there to observe the change rather than to try and make a change" (P1).

There are ongoing active management interventions to remove invasive species, "And in the case of like the fire... we're trying to deal with the invasive species, but we're letting...regeneration happen as it is going to happen under our current climate" (P4). There are also plans to continue with the programs of prescribed burning to restore fescue prairie, and whitebark (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) restoration. "That's one form of active management...to...manage wildfire risk... or...manage for ecological integrity goals...if there's a species at risk needs a certain habitat that we can influence with fire" (P7).

In terms of rebuilding infrastructure that was burned in the fire, trying to achieve "conservation gains" is generally the approach taken. For example, a participant explained that the Crandell Campground had always been a hotspot for human wildlife conflict as it sits at the

confluence of two valleys and bears were constantly in the campground (Figures 4.7, 4.8, and 4.9). In reconstructing the Crandell Campground, a participant explained that the park took the opportunity to achieve conservation gains in the form of creating a wildlife corridor to reduce conflict:

“It's kind of been a reset for some of these projects...if the fire hadn't gone through... trying to make that kind of...assessment wouldn't have been there....It's...brought some unique opportunities for the park to upgrade some of the infrastructure and offerings to visitors as part of the recovery” (P12).



Figure 4.7: 1914 photo taken from Blakiston Shoulder, Station #84, by M.P. Bridgland.

This photo is looking eastward and highlights the abrupt transition from mountain to prairie (Photo #: 549).

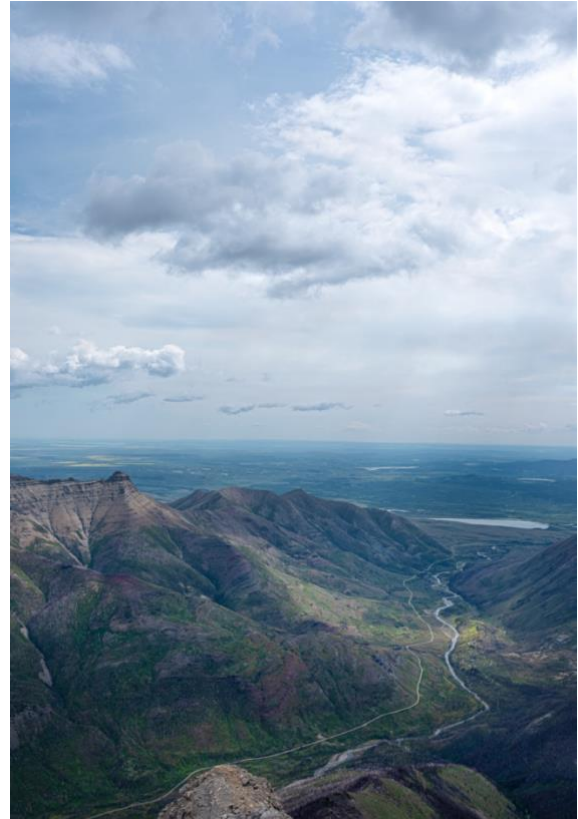
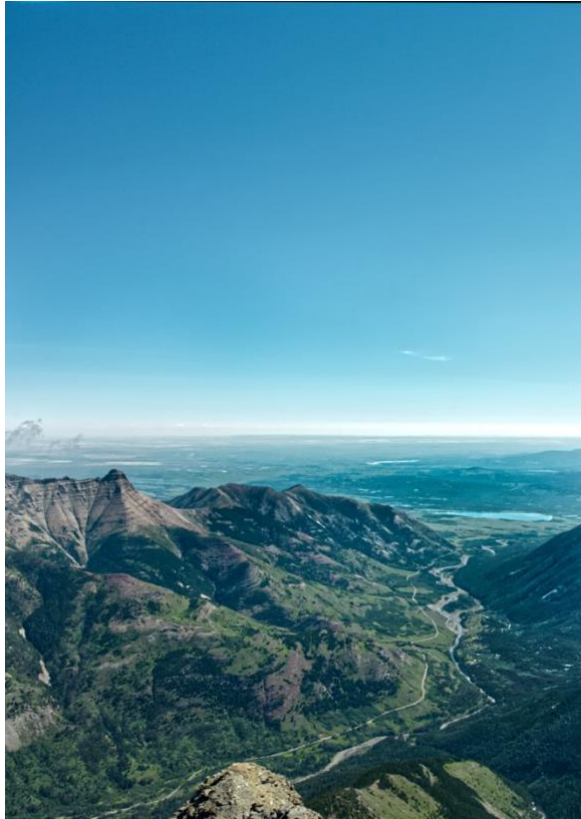


Figure 4.8 (Left): 2004 repeat of Bridgland’s Blakiston Shoulder Station 84 (Photo #: B0013P0021; Date: August 10th, 2004), and **Figure 4.9 (Right)** showing the 2019 third-view (Photo #: DSCF3890; Date: July 15th, 2019). The Crandell Campground, where conservation gains were made in reconstruction, is visible in these photos on the bottom right.

The following section outlines the ways in which the Kenow fire impacted restoration projects and participant’s thoughts on emerging concepts in restoration such as novel ecosystems and assisted migration.

3.0 Ecological Restoration and the Kenow Fire

The major restoration projects in WLNP include invasive species management, fescue prairie restoration, whitebark and limber pine restoration, restoration of aquatic ecosystems

(restoring bull trout populations), and restoring gravel pits created in construction projects.

Participants explained that the Kenow fire created many challenges but also some opportunities for ecological restoration.

Perhaps the biggest opportunity that has come from the Kenow fire is the ability to do more prescribed burning in areas of the park that were previously too risky to consider: “It’s ...taking some of the operational risk out of some other projects we would never have considered doing before....the horizon is expanded now as to what’s possible” (P11). Much of the park was contiguous forest prior to the Kenow fire and now that the canopy is removed fire management can take advantage of more opportunities to burn when the weather is right. For example, figures 4.10 and 4.11 show extensive forest and forest encroachment into grassland and meadow over the past century, and 4.12 shows the same view post Kenow fire. Prescribed burning is a tool that helps the park achieve their ecological integrity management goals of preserving grassland and meadow that is threatened by encroachment. A participant explains the importance of continuing prescribed fire: “People...in Pincher say... you guys aren't going to burn for years now. And...actually, it's more important than ever to get heterogeneity...patchiness and processes on the landscape” (P5). The fire management plan is also being re-conceptualized in light of the Kenow fire and the new plan may follow a zoning approach. In this approach, some zones of the park are designated as areas where full fire suppression efforts would occur because of threats to public safety, infrastructure, or other landscape values. In other zones, fires could be let to play out without intervention if the weather is right and there is no threat to the aforementioned factors.



Figure 4.10: Bridgland's 1914 Anderson station, #85, from 1914 shows extensive forest even then, but more open meadows and grasslands compared to the modern landscape (Image #: e004414417).



Figure 4.11: Repeat photograph from 2004 showing forest encroachment into meadows on eastern slope over the past century (Date: 7/22/04, Photo #: B012P0005).



Figure 4.12: Repeat photograph from 2019 showing the extent of canopy removal after the Kenow fire, potentially opening up more opportunities to prescribed burn to encourage meadow and grassland habitat (Date: 7/12/2019, Photo #: DSCF_3847).

Many participants explained that the park is much more vulnerable to invasive species now that there is more exposed soil and less competition from native species as they will take time to re-establish. The remote parts of the park, at higher elevations especially, have more exposed soil than the lower parts of the park as succession is not happening as quickly there. In the summer of 2019, I witnessed large patches of barren ground while conducting repeat photography from Festubert Mountain in the western reaches of the park, and while walking to many other stations there was still much exposed soil surrounding regenerating plants. A participant explains:

“I think right now our biggest challenge is invasive species... I feel like our teams are like that little boy holding their finger in the dyke....In the National Park context, we can't...just get out in the landscape and start spraying

herbicide like crazy. However, having said that, we're going to have to start doing something more and more aggressive because...just weed pulling on a landscape the size of a national park, however small, Waterton's a fairly small place, we just can't manage and keep up" (P13).

To address the incursions by invasive species WLNP follows a “early detection, rapid response” protocol, especially now after the Kenow fire. On deciding when to intervene, one participant advised to look at the mandate first of all, and then explained,

“You look at what you know, you look at what you don't know. You also look at what you're capable of doing versus what you're not capable of doing.... Is a weed invasion in an area so bad that you could spend millions of dollars and achieve nothing, but yet over there a weed invasion has just started and if you just sent one guy out for an afternoon you could actually stop a weed invasion that you could spend the next 20 years fighting.... So like [for] me, send the guy out to the little plot for the afternoon and solve that problem” (P5).

Another participant described being surprised about where non-native species have shown up after the fire, saying that they are “more remote than you would think,” adding, “there hasn't really been any human presence, but that seed bank has been there somehow...and has been waiting for this disturbance to establish itself” (P4). To combat invasive species establishment WLNP introduced the Play, Clean, Go program in 2018 which is a program meant to educate visitors on how they act as vectors for invasive species and encourage them to clean their gear prior to commencing recreation activities. The program was created in Minnesota and adopted for broad use across Canada by the Canadian Council on Invasive Species (CCIS) in 2016 (CCIS, 2020). Boot cleaning equipment was installed at major trailheads and volunteers will be stationed there to engage with and inform people about to embark on the trails.

Less related to the Kenow fire, there are imminent threats to the integrity of aquatic ecosystems in WLNP from invasive species. Quagga mussels are an invasive species from the

Baltic region and have been spotted a mere three-hour drive from the park, in Montana. They have the potential to lay waste to Waterton's aquatic ecosystems. The threat cannot be understated, as one participant explains: "Our ecosystems have been relatively stable since the last glaciation. We're the only place in the world that has native northern pike, native lake trout, native bull trout, native cutthroat trout with our mycid shrimp as well as deep-water sculpin and pygmy white fish...the only ecosystem in the entire world that has all those together" (P10). They have put strict 90-day quarantine measures and mandatory inspections in place for all watercraft entering the lakes to try and stop quagga mussel invasion. Even so, the participant admits that they "lose a little sleep over it" (P10).

The Kenow fire was not as directly impactful to aquatic ecosystems as prior disturbances were such as the 2013 flood. However, the fire had some initial impacts such as altering water chemistry and causing heavier amounts of runoff to flow into streams. Furthermore, it remains to be seen what potential impacts there will be with regards to the standing dead wood in the burn area. One thing that the MLP photos from 2019 show is the vast amount of standing dead trees (i.e. snags) that remain after the fire (Figure 4.9). Many participants pointed it out and there was speculation about what it would mean for aquatic ecosystems. The standing wood could eventually act as a "renewal of aquatic ecosystems" (P10) as the wood makes its way down into the creeks, one participant postulated. I was told that past management in the mid to late 20th century tended to remove all woody debris from creeks whereas present management manages for habitat structure in aquatic ecosystems which includes woody debris. Another participant worries about a blowdown wind event or another flood occurring and potentially destabilizing the slopes above critical habitat for bull trout, causing significant amounts of run off. In such a case, participants explained that actively intervening on

such a large scale would be a challenge to the park's capacity: "It's not something that we can actively manage" (P13). In addition to this, the Cultural Resources team, guided by indigenous peoples, may need to triage which sacred sites to save because standing dead wood will fall over and damage some sites.

The Kenow fire created opportunities and challenges for the whitebark and limber pine restoration program, according to participants. Burned sites are optimal for planting new seedlings because of available soil nutrients and the lack of canopy. Therefore, there are potentially many more sites available for restoration: "It did open up opportunities for more planting without having to do a prescribed burn...we try and plant in burns because it significantly increases their chances of survival" (P4). There are no climate models guiding planting site selection for whitebark and limber pine within the park, "We don't have... a model for where we should be planting right now" (P4). Climate change is just one of the many threats to whitebark and limber pines, along with white pine blister rust, mountain pine beetle, and altered fire regimes (Figures 4.13, 4.14, & 4.15). When considering the multiple threats, especially climate change, a participant says "It's kind of frustrating because there's not like a clear path of action of like, it's kind of just hanging in there and we don't have a real strategy to mitigate it" (P4). One participant opines about whitebark pine and climate change, speculating that:

"There's a real possibility they're going to get pushed off the top of the mountains anyway. So I don't expect anybody currently alive is going to be around long enough to see white bark pine stands in the sense we knew them unless there were residual ones that have escaped the burn somewhere" (P8).



Figure 4.13: Lakeview Ridge, Bridgland's 1914 Station #79, showing a lush stand of krummholz whitebark and limber pine trees in the right foreground (Photo #: e004414399).



Figure 4.14: Lakeview Ridge from July 20, 2004. Whitebark and limber pine trees are showing signs of stress from white pine blister rust. (Photo #: B010P00023)



Figure 4.15: July 17, 2019 photo from Lakeview Ridge showing the loss of mature whitebark and limber pine trees in the Kenow fire. (Photo #: DSCF_3938).

I was told by a participant that a large part of the whitebark and limber pine restoration program in WLNP and elsewhere is trying to increase the disease resistance of these tree species across the landscape. To do this, field crews survey for living mature trees that they think are resistant to white pine blister rust, and once they find them they cage and collect the cones. The cones are sent off to laboratories to be grown out and tested for their degree of resistance, a process that takes 5 years. The Kenow fire killed many of the trees that were awaiting testing and thousands of newly planted seedlings which was a large setback in the program. While the whitebark and limber pine restoration program continues, some participants are reflecting on whether they should continue planting thousands of seedlings or whether it is a wasted effort, whether they are “sending them to their death” (P13) because of climate change. Furthermore,

the restoration program is highly collaborative across jurisdictions, and one participant raised a question of the efficacy of sustained interventions across all jurisdictions, explaining:

“So white bark pine, for example, ... it's worth saving as a species, is it worth putting a lot of effort into saving that species here in Waterton in particular? And then [in] Banff, ... and then BC would say we should do that in our habitat, and the US Forest Service would say we should do that in all of the places, ... but that's everyone doing it all, everywhere. So maybe that's not the most effective way to use those resources. And that's why there's a whole team on that that's doing a recovery strategy to try to model where the most effective places are, because there's only so many trees that are rust resistant, and we should put those seeds into places that have the highest probability of early success” (P2).

For now, WLNP is focusing their efforts in planting within the “scope of history” (P4) partly with hopes that beneficial mycorrhiza will still be present in the soil to assist in seedling growth and success.

Participants all recognize the value of historical information in guiding ecological restoration even though its use is limited and context specific. For example, as mentioned previously, the knowledge of where whitebark and limber pine existed on the landscape historically can be valuable for choosing planting sites. Additionally, knowledge that there used to be much more frequent low-severity fires from historical indigenous burning practices, before fire suppression occurred in the early 1900s, guides the prescribed burning program. A participant commented on the goal of the fescue restoration program, saying they are “slowly turning it back into what it used to be before full fire suppression” (P14). Despite this, one participant highlighted that limited historical knowledge is available and setting management goals like less aspen and shrub, and more meadow and grassland, is “the best we can do in some cases” (P7).

Reference sites for fescue prairie restoration are contemporary sites that are nearby to the restored site, rather than the historical ecosystem state. Many participants expressed agreement for the impracticality of restoring historical ecosystem states in the classical sense of using history more as a blueprint, with one participant saying “It is folly to use history as a blueprint and would waste taxpayer dollars” (P13). For example, it would be next to impossible to set goals for bull trout restoration based on species populations of 100 to 150 years ago, nor may it be possible to restore whitebark pine populations to the extent they previously existed in the face of multiple stressors, participants explained. Another participant paraphrased Greek philosopher Heraclitus, saying “You can never cross the same river twice because it’s not the same river” (P8).

The focus for restoration in WLNP is keeping parts and processes intact and within the natural range of variability. Commenting on history’s role in restoration, one participant said:

“I think it's really fascinating..., particularly in parks, because they were created at a certain timestamp, and particularly the mountain parks where we have ... this legacy of photos, this legacy of...what it should look likeThere's always been this push to well, it should go back to the way it was...[to] that first historic photo when we first got there, and I think that's misguided. Also, ... everything changes, it comes and goes. And I think that's one of the big challenges of restoration is what does that mean? What are we trying to put it back to? And so mine is the parts and the processes, if you can preserve them then let it figure itself out” (P1).

Along the same lines another participant stated, “[I] can’t predict the future. I can’t predict what tomorrow is, I only know what happened in the past...you just put the right species out there and let them sort themselves out, at least you try to do your best to do that” (P9). In this context the right species are native species.

Participants stated that there is no clear path for how to adapt to climate change including in restoration projects. One participant stated, "Managing in the face of climate

change...remains a little bit of an amorphous thing, right, like, what do we do? I think I think one of the challenges is that, you know, climate change does not work on political and career and park management plan timelines” (P13). Though the path isn’t clear, I was told that informal brainstorming about climate change is a normal practice within WLNP. More formal climate change adaptation discussions in Waterton Lakes began in the spring of 2020 as WLNP took part in national climate change workshops, and more are planned for the fall to discuss how to adapt monitoring measures to climate change and ensure they are monitoring the right things. On the challenges of adapting monitoring measures, a participant stated “It's uncertainty, we don't know. So we...try to use the best science that's available and do what we can...there's no easy way to go about it” (P14). Another participant mentioned that a speaker was coming to discuss with the prairie and mountain parks how to “integrate climate change into restoration thinking” (P9).

The cultural resource unit is also participating in the ongoing climate change adaptation workshop series, as one participant elaborates on:

“You’re probably already aware that Parks Canada takes climate change very seriously. We’ve got a series of workshops across the country that we’re participating in, and cultural resource management is...a building block of that series. So yes, ...we’re aware of it and we’re planning for it.... But, the plan to be intellectually aware and then to actually go through it are two different things” (P3).

Environmental assessment also lacks clarity on how to adapt to climate change, a participant remarked, “That's an ongoing challenge... Legislatively, it's supposed to be considered, but it's not...it wouldn't be the key feature of our assessment” because they are focused on “assessing current conditions as you know it” (P12). They went on to say that discussions are happening around climate change but that “how we really consider it and how we factor... [it] in, it's still kind of uncertain” (P12).

Linking to the Kenow fire, another participant stated that: “[The Kenow fire] has kind of been an impetus for us to start thinking about climate change.... This is a huge change that happened. Now there's going to be a whole bunch more gradual change that's happening over time. So how....is that going to affect...the post fire... recovery?” (P14).

Discussions in WLNP around where to source seed for fescue prairie restoration projects taking climate change into consideration have entertained the idea of sourcing seeds from further south in the US. Most seed used in restoration projects is collected within the park, though at times appropriate seed needs to be sourced elsewhere or from the market. However, participants say there is still a lot of uncertainty around sourcing seed from southern regions and that they don't feel a need, or that they are ready, to go down that path yet.

“I get challenged, like if I'm developing a seed mix for restoring a fescue prairie, they say, why am I just seeding in the species that are currently existing there? I should be thinking about what the climate will be like 20 or 30 years and planting accordingly.... I don't necessarily agree with that, because nobody really knows what's going to happen in 20 or 30 years. And which environment am I planning for? Am I giving up on fescue and trying to plant...short grass prairie that's native to Colorado? Is that that my new system that I'm supposed to be planning? ...Nobody really has an answer to these challenging questions” (P9).

A participant explained that collecting seeds locally in a diversity of habitats, both wet and dry, or in both wet and dry years to try and select for local adaptations to a warming climate is a potential path forward for fescue prairie restoration, though it is still in the idea phase. In a different vein, one respondent muses, “I guess we're kind of working...somewhat on faith that fescue grassland will be adapted to the climate of the future” (P4).

Finally, even though climate change dominates the media it doesn't mean it is necessarily the highest priority for people living in and around parks. On the “What we Heard”

webpage where WLNP reported their findings from public consultations on the 2020 Management Plan (Parks Canada Agency, 2019f), climate change ranked fifth in the public's eye as a management priority for the next decade. The public was most concerned with increasing visitation and how to manage that effectively, followed by understanding the impacts from the Kenow fire, invasive species management, and upgrading infrastructure. Other climate change adaptation actions that the park is undertaking is transitioning some of their vehicle fleet to electric and installing electric car chargers.

I asked participants about the concept of novel ecosystems and ecological novelty (their distinctions are outlined in Chapter 2), as it is a prominent topic in ecological restoration. I was told by a participant that the concept came up in some of the national climate change adaptation workshops. Every participant I talked to had heard of the concept of novel ecosystems. No participants stated that they were advocates of the concept, though some were open to at least paying attention to it given how fast things are changing. One stated, "I think there's some validity to it...there's obviously going to be some changes that are going to happen and there's nothing we can do about it" (P14).

There were concerns raised about the novel ecosystem concept among the participants. Primarily this concerned the fear of giving up on invasive species, which goes against the mandate of Parks Canada and the systems plan (protecting representative ecosystems of Canada). A participant stated that the systems plan "still means something to me" and that "I think the novel ecosystem approach is a bit of a red herring [in] that all of a sudden you go...okay, there's no...representative ecosystems anymore and everything's going to be novel" (P13). In one critique of the concept a participant said "It seemed to me like fundamentally it was...people going through a mental exercise to justify giving up working on these invasive plants. Like it

was putting ...a lot of mental energy to come up with a way to say it's okay not to control invasive plants” (P9). This participant said they would prefer if energy was put into development of genomic technologies such as CRISPR that can target specific invasive species: “I think that that is the future, that's what we should be putting our energy into” (P9). A participant commented on the link between novel ecosystems and restoration, saying “If you were to tell me that the way to go forward is just novel ecosystems, then I wouldn’t do anything for restoration, right? I would just go, well fine, then it’s all just going to be novel, and we’ll just let it play out the way it wants to play out” (P13).

Participants commented that climate change or altered disturbance regimes will potentially cause community species assemblages to be different than they once were, mostly regarding species that naturally exist in the region or close by:

“So you might see some species with other species that they'd never mixed with before... that would be a totally valid... new. I don't know if you could call it a novel ecosystem, if...they're all things that were still kind of in the area. They're sort of moving around in relation to where they used to be....I don't really like the idea of letting noxious invasive species into that idea” (P14).

Another participant stated: “The new climate is creating conditions that...nature will...restore species communities in within, and... we’re not going to play around with it, right.” (P7). Though it will be some time before a clear picture emerges about what ecological trajectory the vegetation communities will take, one participant reflected that: “Maybe in some cases it's....something that we have to accept, that things are not going to come back as they were before the fire, like after a major disturbance event” (P4). Another remarked, “There's obviously going to be some changes that are...going to happen and there's nothing we can do about it” (P14).

If novel ecosystems were to arise naturally by birds bringing in new seeds to the park, one participant admitted they would have an easier time accepting that than if the seeds were brought in by humans, asserting that, “I think humans have been the big driver of a lot of these species spreading across the planet, and I think we bear some responsibility...for mitigating the impacts of some of that” (P11). Some participants said novel ecosystems may already exist on the landscape referring to dandelions providing important ecological functions, the lack of bison on the prairie, and introduced turkeys that are no longer killed by cold winter temperatures. Perhaps most notably, hybrid and introduced fish that have become naturalized in streams, to which a participant said “you have a novel ecosystem, it already exists on the landscape” (P2). One participant commented on change, saying, “In some ways...this is not a new idea, this is what happens” (P5). In a similar vein, another participant commented on tipping points and how many parks may have already reached them, or will soon enough, saying “we don't have the resources...in many situations, so...as we get closer to those tipping points in more places...we're going to have to triage” (P1).

Related to discussions of novel ecosystems is that of assisted migration. Climate change is forcing difficult decisions to be made around the endangered bull trout in WLNP. A participant explained that the streams where bull trout thrived historically are now warming up beyond the threshold for suitable habitat which is around 16°C (ideally 12-14°C). Apparently, there has been some modelling done to assess which creeks in the Crown of the Continent will stay cool enough for bull trout under climate change. From what I gathered from participants, there has been discussion around moving bull trout into cooler creeks to help protect them from climate change, even though they weren't in those creeks historically, though no official decisions had been made. In addition to climate change, introduced brook trout outcompete bull

trout in the warmer creeks and breed with bull trout creating hybrid fish, polluting their genetics.

A participant elucidates this further:

“The habitat is better suited for some of these introduced, I say invasive species, but we were the ones that stocked them and managed for them, we still manage for them...So... maybe if we want people to fish in the future, if we want...trout as a top predator, maybe...we have to accept that brown trout are going to be replacing bull trout on the lower portions of these watersheds. I don't know if they function the same. They may eat amphibians more than bull trout ever ate amphibians. So if we accept brown trout and we accept brook trout, maybe we lose leopard frogs.... it's, such a complex thing...it's not as simple as just saying oh we're switching one trout for another” (P10).

There were diverging opinions on whether the concept of novel ecosystems, or the related issue of assisted migration, would have a place in ecological restoration in Parks Canada in the future. Some participants said it was likely eventually, and others said no and in some cases they would be actively opposed. The discussion around these issues in the agency was said to be controversial. One participant shed more light on the issues, saying that:

“I think Parks is really grappling with them because it is really such a conservative institution and [there is] a real desire to keep ...maybe the last refuges for some things that aren't novel. If maybe this is the one place we should put the extra effort into not letting that happen. It's the same with assisted migration...do we let the bull trout all die out or do we actually put some into areas where they're actually going to be in a climate refuge, even though they weren't historically there? I think those are two of the main philosophical challenges that we have in protected areas. And I know that there's people at all levels in the organization that have extremely different opinions ...both on novel ecosystems and on assisted migration. Or species at risk, when do you just say, okay, enough is enough, ...we can't do it, we can't save it” (P1).

This same participant also articulated that, “Those are all questions that are, I think, a challenge anywhere, but they're particularly challenging where you're trying to say these are the last vestiges of where human influence isn't as likely to have an influence” (P1). In the next

section I will outline some challenges participants' discussed in the interviews about how the park handled some aspects of the aftermath of the fire.

4.0 Challenges in the Post-Emergency Response

There was consensus among participants with the impressive and proficient way that Parks Canada responds to emergencies such as wildfires as they are happening. There were significant public safety risks associated with this fire because the townsite is located within the park. In many respects that is what made this fire notable, because much larger fires happen in places like the boreal forest and go unreported in the media because there are no threats to public safety, according to one participant. Relations between the park and town residents have been fraught with tension in the past, however many residents were appreciative of the way in which fire prevention and emergency response efforts took care of their interests because the townsite was mostly undamaged for the fire (Figures 4.1, 4.2, & 4.3). On this topic, one participant explained, "It was unifying, I think for the town...How long that will last, who knows....For the social side, I think it was an interesting experiment. A lot of people that...really hate parks actually said thank you which is not something you see very often" (P1).

Despite handling emergencies with precision, many participants commented that in the wake of the fire that Parks Canada struggled more with organization and providing adequate resources in a timely manner. A participant stated:

"Parks Canada historically... through many of the incidents we've managed, whether it's flood relief in Waterton or wildfire, ... or the flooding on the Trans Canada in Calgary...in 2013, we do... immediate crisis management really, really well...Where we're less good is the afterwards part" (P13).

Criticism was voiced by some participants about how the park handled some aspects of the aftermath of the event. A participant expressed that:

“Right after the fire the park was not in a good space...we didn’t really know what to do. And then it was just a big push to get all this funding to help us fix the park and it was like we were going for the golden goose and dumping everything in this post fire thing and ignoring everything else and we just wanted money, money, money, and I don’t think there was really good planning... no forethought in what we actually needed to do and our priorities” (P9).

In a similar vein, another participant explained that some infrastructure projects lacked clear objectives which became a challenge as pressure mounted to get things built and get the park open to visitors. Elaborating on the challenges of completing post-fire infrastructure projects and echoing aforementioned comments, a participant explained:

“I would say there was complexity in...unrolling [the infrastructure] program ... in that the funding support systems weren’t really set up for disaster response, like Parks Canada is so good in emergency that you forget that ...when we revert back to our normal operations, we’re actually not very nimble...and it just didn’t work for the nimbleness that we needed immediately after, and that’s not saying anybody is at fault...it’s just...when has the organization had to do that?” (P5)

In contrast, the ecological integrity program was said to be more seamless in the way it unfolded.

Workloads doubled or tripled in size after the fire to gather essential ecological monitoring data necessary for long-term post-fire research, and to address a significant amount of infrastructure and public safety projects that needed to occur before parts of the park could be safely opened to visitors. Initial funding from the Parks Canada Agency was helpful in addressing much of the immediate work that needed to happen, but there were some delays in

accessing the funds that hindered the capacity needed to undertake the work in a timely manner. One participant explained, “We’d get the funding, but it would be delayed and so you couldn’t hire.... And then you don’t have time to hire because you’re so busy doing the job that you should have hired for already” (P5). As previously mentioned, the increased workloads were a cause of stress for many of the participants and resulted in high turnover rates in one of the departments of resource conservation. That same participant wanted to note, “It’s not like...the agency failed us or anything like that...it was just, that is [what] the outcome of events like this is, you know” (P5) and reiterated that there was a lack of capacity to manage the work that needed to be done.

Furthermore, according to one participant it was challenging, and remains so, to get sustained funding and attention from the Parks Canada Agency to address all the projects that need to be completed in the park in the face of many different priorities across the country. “We’ve had a real challenge to convince the Agency that we need to continue to pay attention to this place, we just can’t walk away now that the fire is out” (P13). Additionally, another participant commented on what they consider a struggle for the Parks Canada Agency:

“How do we manage for the recovery of these situations?... Like where there’s a national park that’s burnt or on the east coast where there’s a big snowstorm and you lose a lot of infrastructure or something....we’re just seeing those more and more. So nobody plans for those. Right? You know, if you have a business plan, it’s not in your business plan....So Parks needs to figure that out, too...But...they’ll get their head around it.” (P2)

Finally, I have already outlined some of the more emotional impacts that the fire had on the participants and others working in the park, and a finding that emerged from my research was that the system in place to address the immediate trauma that can emerge after events such as the

Kenow fire could be strengthened. One participant who was involved in getting staff the immediate emotional and psychological help they needed stated:

“I’ve been in parks a long time, and I’ve often been the only female around and it just seems to fall on me. So whether it’s a visitor safety event where there’s mortalities involved... I often end up being the one on the social end with no training. So I found...that was one of the most stressful parts was feeling someone had to do something and feeling out of my element because it’s not my expertise” (P1).

While stress was high, many participants commented on the fact that there still was a lot of support available from the Parks Canada Agency and the team in Waterton was supportive to one another throughout the fire and in the aftermath. Some called for an audit or assessment to be undertaken to look at what structures and processes worked, and which did not to be able to learn from, adapt, and share knowledge with other parks.

Discussion

As I discussed in Chapter 2, the national park management landscape has shifted over the past century. When parks were created, it was thought they would be “preserved in perpetuity” with no intervention. At the time, it was thought that putting out fires was necessary which was quite a massive intervention in park ecosystems. Parks are currently managed for ecological integrity, often to ensure natural disturbance regimes are intact. The boundaries of what is acceptable or desirable in managing parks are being challenged once again as there are now calls in the literature for increasingly interventionist approaches such as assisted migration, conservation triage, and managing for novel ecosystems to help park ecosystems adapt to climate change and other pressures of global change such as pollution and invasive species. It is this

shifting management landscape that inspired me to pursue this research, asking the question: in what ways does the severity of the Kenow fire, and the staff's experience with it, shape the way they are thinking about park ecosystem management and ecological restoration? In other words, in what ways does their experience with the fire shape their attitudes toward intervening in park ecosystems in the form of ecological restoration?

There are three principal areas for discussion that arose from my research findings that contribute to answering my research question. For my discussion I will first discuss the approach to post-fire management in WLNP as it relates to existing management principles and guidelines. Second, I will link the participants views around the present and future potentialities of ecological restoration within a landscape significantly altered in a time of climate change to the broader literature in ecological restoration. Specifically, I will discuss the role of history in ecological restoration, emerging ecological novelty, adapting to climate change, and the human dimensions of conservation. Lastly, I will discuss some of the challenges that came to light regarding Parks Canada's post-emergency response.

At the heart of my research is the question of when to intervene in park ecosystems, and whether to intervene at all. This question has been an enduring dilemma facing park managers since the transition from parks as pleasure grounds to be left alone and preserved to the present day where they are managed for ecological integrity and recreational use, and likely always will be (Dearden & Dempsey, 2004).

The approach WLNP is taking to manage the park's ecosystems after the Kenow fire is guided by both active and passive adaptive management approaches, as they both had equal numbers of quotations associated with them in the coding process. Findings from my interviews indicate that a "let nature take its course" approach is the way they are framing their approach to

managing the park. This suggests they are managing for naturalness in the form of self-willed nature, in other words, not being controlled by humans for any goal (Aplet & Cole, 2010; Cole & Yung, 2010; Landres, 2010). Participants stated, “We don’t have a target for this” (P2), and “There’s just so many unanswered questions that in my opinion, you’re best off to just let nature figure out...what the next stage is and let things adapt” (P1). At first listen, this statement comes off as being a fully passive, hands-off approach to management. However, it is just one strategy embedded in a diversity of management actions being employed across the landscape in WLNP. Active intervention to manage for specific values that WLNP wants to protect such as whitebark pine, rough fescue, and countless other species that could be threatened by climate change and invasive species was occurring before Kenow and will continue in the wake of the Kenow fire.

As the participants described, WLNP is not actively guiding, or controlling, the ecological trajectory of the burned areas in that they are not planting or seeding species, with the exception of whitebark and limber pine which was a restoration project already in place before the Kenow fire. For example, WLNP is not using the Kenow fire as an opportunity for more interventionist experimentation such as planting novel species mixes or species that are adapted to more southern climates; Leverkus et al. (2019) and Halofsky et al. (2018) suggested this was a potential opportunity for ecological restoration after wildfires, and Lemieux et al. (2011b) said it was a potential role for ecological restoration in adaptation to climate change. This approach is consistent with recommendations for post wildland fire management from Beschta et al. (2004) & Noss et al. (2006) and the IUCN restoration guidelines (Keenleyside et al., 2012) which recommend not initiating large restoration projects in disturbed areas unless there is a threat to ecological integrity. Furthermore, passive management may be appropriate when the scale of the problem is too large to address through active management (Lawler, 2009). When the public

inquired about tree planting, seeding, or salvage logging, a participant commented “Can you imagine the scale of that,” (P7) which hints at serious capacity issues for large scale restoration, and affirmed their thoughts on their approach to management saying, “We just let nature take its course” (P7). Another participant was concerned with the potential negative impacts restoration can have, saying “I think there's been lots of failed experiments ...trying to do restoration post-fire in the US.... they end up with...big fields of invasive plants” (P9). However, WLNP is removing invasive species and continuing to conduct prescribed burns as these activities support their ecological integrity goals. The extent of intervention of both these activities may amplify given the scale of the burned area. For example, another participant said, “We're going to have to start doing something more and more aggressive because...just weed pulling on a landscape the size of a national park, however small, Waterton’s a fairly small place, we just can't manage and keep up” (P13).

The Kenow fire has increased the potential for doing more prescribed fire interventions in the future now that much of the forest canopy is removed and there would be less risk of a fire getting out of control and endangering the public. “It's ...taking some of the operational risk out of some other projects we would never have considered doing before....the horizon is expanded now as to what’s possible” (P11). Prescribed fire would be used to help maintain meadow and grassland habitat in WLNP, by targeting regenerating lodgepole pine (*Pinus contorta*) stands before they reach maturity and produce seeds, as an example. An increase in area burned and an increase in meadow and grassland habitat across the landscape would help achieve WLNP’s targets for ecological integrity (Parks Canada Agency, 2019b). Ongoing prescribed burning after a wildfire is also an approach to assist adaptation to climate change. A participant stated that “It's more important than ever to get heterogeneity...patchiness and processes on the landscape” (P5).

Prescribed burning maintains successional heterogeneity across the landscape, creating early successional patches that are well poised to adapt to current and future climate conditions (Millar et al., 2007). Prescribed burning also helps restore the historical fire regime and landscape structure characterized by tree clumps with older remnant seed trees, and will reduce fuel buildup which will ultimately limit the potential for highly severe fires in the future (Hessburg et al., 2015; 2019).

Removing invasive species is another primary active management activity being employed: “And in the case of...the fire... we're trying to deal with the invasive species, but we're letting...regeneration happen as it is going to happen under our current climate” (P4). Removing stressors such as invasive species is a conventional management strategy that is in line with what previous studies have reported as being favoured by managers and generally perceived as effective and low-risk (Hagerman & Satterfield, 2013; Lawler, 2009). Discussions in my interviews suggest that removing invasive species is seen as increasing the ability of the landscape to renew itself under a changing climate with less competition from the external threats of invasive plants. This suggests that they are embracing nature’s autonomy to the degree that this is possible while also being fully accepting of the fact that they will also have to intervene.

Waterton has one of, if not the largest, non-native plant programs in all the national parks because it is adjacent to agricultural land which heightens the threat of invasive species. Further, I was told that WLNP has more resources than a lot of other parks which is largely due to having a townsite within the park generating revenue, but also from successful applications for funding from the national Conservation and Restoration (CORE) program. Some parks don’t have as many resources and rely more on knowledge sharing from other parks, such as Waterton,

and one participant explains that “it can be sort of frustrating to hear that some of them [other parks] are really struggling just to do the real basics” (P7). The non-native plant program was able to hire a few more summer students but has remained relatively unchanged after the Kenow fire. With that being said, one participant said “we don't necessarily fully grasp how that's [non-native species program] going to change” (P14) amidst the uncertainty of how the landscape will renew itself under a changing climate.

Both main interior roads were closed for two summers following the Kenow fire to address public safety issues such as damaged signs, guardrails, and falling trees and rocks. Visitors were able to rent bicycles and ride up the Red Rock Parkway. Because of the positive feedback they received, WLNP is considering closing the parkway for one day each week so that visitors can enjoy biking or walking up the parkways which could reduce, even if slightly, threats to ecological integrity from car-based recreation including noise, threats to wildlife, and pollution. In the past, it was boldly suggested by the 2000 Ecological Integrity Panel that one parkway be closed permanently to remove threats to ecological integrity: “Given the impacts to ecological integrity of intensive, car-based recreation, it seems reasonable to evaluate removal of one of the roads and its accompanying facilities” (Parks Canada Agency, 2000, p.12-7). The potential action to minimize car-based recreation, even if for a day a week, balances Parks Canada’s dual mandate of conservation and recreational use. The Play, Clean, Go program was adopted to educate the public on how they are vectors for invasive species and mitigate the public’s impact on recently burned areas, having the added benefit of engaging volunteers in stewardship (Keenleyside et al., 2012). The management actions outlined in this section are consistent with the Parks Canada Restoration Guidelines from 2008, and the IUCN guidelines (Keenleyside et al., 2012), though participants did not mention these policy documents.

The management approach does not diverge from the current paradigm of park management which aims to intervene if there are threats to ecological integrity but generally favours minimizing intervention when possible (Theberge et al., 2016). When deciding to intervene, or when intervening, history still matters in multiple ways in a renewing landscape.

Participants accepted that the post-fire landscape in WLNP may look different than the pre-fire landscape because natural regeneration is happening under a new climate. Recall a participant stating “The new climate is creating conditions that...nature will...restore species communities in within” (P7). This acceptance is also exemplified in the framing of natural regeneration as *renewal* and a lean toward letting nature take its course. “We don't have a target for this. We just want to see what happens” (P2). The word renewal’s root, *renew*, means “To make (something) new, or like new, again” (Oxford English Dictionary, 2020a). It was chosen because it is suggestive that things may look different, or new, and it reflects the uncertainty over what trajectory the landscape may take: “We use the word renewal because it's sort of more open ended...it'll be whatever it is” (P7). This is compared to a word like “recovery,” which has attached to it an expectation that things may go back to the way they were. Recover means “To regain (something lost)” (Oxford English Dictionary, 2020b). When I travelled through Kootenay National Park in the summer of 2020, I read in their visitor pamphlets that they also framed vegetation regrowth after the Verdant Creek fire as renewal. This harkens back to the diagram by Aplet & Cole (2010) that showed that recovery to a “pristine” natural condition is unlikely under global change.

When I first considered what renewal meant, I thought it suggested an opening up to possibilities of change and a severing of the tie to historical fidelity in that staff were accepting that the landscape may look significantly different than it did in the past. I thought this was an

interesting place for a National Park to be because of how critical the idea of historical fidelity is in Parks Canada. Upon thinking about this further, even though the park is framing regeneration as renewal, their approach to park management still incorporates many qualities of historical fidelity, or historicity, while at the same time being open to change. Historicity is a crucial pillar of ecological restoration, along with ecological integrity, as outlined by Higgs (2012) and Higgs et al., (2014), and its role in restoration has also been changing over time.

History is still relevant for the participants in their practice of ecological restoration, and various types of historical knowledge, as described by Higgs et al. (2014) (Figure 2.3, Chapter 2) are engaged. One of the ways that a historical perspective is still relevant is by acting as “governor,” a governing force that reigns over decision making (Higgs et al., 2014). With a knowledge of the dynamism of ecosystems through time and the ways in which humans have influenced ecology historically, the governor role of history helps ensure people are cautious as they determine when or if to intervene in ecosystems rather than giving in to potentially self-serving whims (Higgs et al., 2014, p.503). Looking at the big picture one participant commented, “I still continue to believe that the past affords a pretty good picture on what the future should be. I think most ecological and geological timeframes...are slow and...we're just here in for a very small piece of that timeline” (P13).

Higgs et al. (2014) argue that by turning our attention to history we show it respect which adds humility and restraint to our restoration designs. They call this a “novel virtue” (p.504) in a time increasingly defined by technological innovation and future thinking. Humility shaped the ways in which many of the participants thought about restoring park ecosystems. “Stop mucking with it” and “Stop playing god” were uttered by one participant, “Because there's so many unforeseen effects of almost everything we do” (P1). The let nature take its course approach

incorporates this element of humility, restraint, respect for the natural world and respect for history. With that being said, letting nature take its course and not guiding the trajectory of the ecosystem in any particular way isn't the only restoration approach that is virtuous. Active intervention can and should incorporate these virtues. Higgs et al. (2014) affirm that history as governor "may end up being of greatest importance in the future" (p.505).

This also ties into another role of history that is alive in WLNP which is "history as redress." History as redress in ecological restoration is concerned with redressing, or rectifying, damage caused by other humans in the past, or rectifying damage from degradation in the present day (Higgs, 2012). In the case of Waterton Lakes, prescribed burning is undertaken with a nod to the fact it was a cultural practice that indigenous peoples maintained for millennia prior to settler colonial establishment which radically altered fire regimes through the practice of fire suppression (Eisenberg et al., 2019). Additionally, restoring gravel pits that were created in construction efforts aims to redress visible human impacts to park ecosystems.

Beyond a governing force over decision making and history as redress, "history as reference" (Higgs et al., 2014), or historical fidelity to past ecosystem states, predominates with whitebark and limber pine restoration. These are smaller scale interventions where a goal such as historical fidelity is more feasible (Cole et al., 2010). References can be based on the historical range of variability also, which acknowledges how ecosystems naturally fluctuate over time (Higgs, 2012). For example, the Mountain Legacy Project photos have been used as references by Waterton Lakes to qualitatively determine prescribed burning goals such as "less aspen and more grasslands" for fescue prairie restoration (P7). This goal is more aligned with the historical range of variability before fire suppression efforts commenced in the 20th century, allowing aspen to proliferate into the prairie ecosystem (Higgs, 2012; Levesque, 2005).

The participants were cautious in speculating what ecological trajectory the post-fire landscape may take: “We use the word renewal because it's sort of more open ended...it'll be whatever it is” (P7). Climate change and the large, contiguous patch size of very high severity resulting from the Kenow fire could be two potential mechanisms that decrease forest resilience (Johnstone et al., 2016). The very high severity nature of the Kenow fire could have consumed serotinous seeds of Lodgepole pines, for example, whose germination is normally encouraged by fire (Johnstone et al., 2016). Seeds, living trees, dead trees, rhizomes, and nutrients, are all material legacies that influence regeneration (Johnstone et al., 2016). The Kenow fire certainly killed larger seed-bearing trees of Douglas-fir (*Pseudotsuga menziesii*) or Engelman spruce (*Picea engelmannii*) across a large area which has increased dispersal distances to living trees, an important mechanism for their regeneration (Stevens-Rumann et al, 2018). If regenerating Lodgepole pine stands are burned again before they are mature seed producers, a transition to non-forest is more likely and the informational legacy of the species could be disrupted (Johnstone et al., 2016; Kemp et al., 2015). Informational legacies, according to Johnstone et al. (2016), are species adaptations to disturbance regimes that fall within the natural range of variability. An increase in the frequency, severity, or intensity of a disturbance has the potential to disrupt informational legacies (Johnstone et al., 2016). “History as Legacy” is yet another form of historical knowledge, in the land itself, that is speculated to be of increasing importance in restoration by Higgs et al., (2014). The legacies of history on the landscape restrict the range of possible change trajectories even in the wake of extreme disturbance events (Higgs et al., 2014). A participant had said, “the past affords a pretty good picture on what the future should be” (P13).

The threshold of what acceptable renewal looks like in relation to the past remains to be determined and will likely shift in relation to emerging data and research, and shifting values of staff, in the coming decades. The roles that history plays in WLNP are most evident in the form of governor, redress, and reference, which encourage humility, and caution, all the while being open to change under a changing climate.

In including a question on novel ecosystems, sometimes phrased as ecological novelty in my interviews, I came from the assumption that novel ecosystems is but one possible scenario, of many, that could emerge on the landscape in WLNP in the future given the high severity and large extent of the Kenow fire. My assumption was also grounded in the fact that climate change is causing species redistributions (Chen et al., 2011; Scheffers & Pecl, 2019), invasive species are becoming more and more prevalent (Vila et al., 2011) and that natural disturbances are catalysts for change (Hobbs & Huenneke, 1998; Jauni et al., 2015; Turner, 2010). It has also become a topic of interest in ecological restoration (Hobbs, Higgs, & Hall, 2013) and park management studies (Hagerman & Satterfield, 2013; Lemieux, 2016).

What I interpreted from many of the participants on novel ecosystems was that the term has negative connotations. It is perceived as giving up on controlling invasive species and thus restoration itself. However, some other participants were more neutral, offering that novel ecosystems may already exist, particularly when thinking about introduced and hybrid fish, as a participant explains: “you have a novel ecosystem, it already exists on the landscape” (P2). Furthermore, there is potential for novel ecosystems arising from species redistributions under climate change which several participants commented on. In linking this fact with what has happened over history, a participant stated “In some ways...this is not a new idea, this is what happens” (P5).

Novel ecosystems is a provocative concept and I interpreted from the participants that the values that national parks represent are in opposition to what novel ecosystems are thought to represent. For example, National Parks are meant to protect representative samples of Canada's diverse ecosystems (Lemieux, 2016). Novel ecosystems are thought to confound this objective, as one participant remarked: "I think the novel ecosystem approach is a bit of a red herring [in] that all of a sudden you go...okay, there's no...representative ecosystems anymore and everything's going to be novel." (P13). Even though ecosystems are dynamic and change is accepted as a reality in national parks, crossing a threshold into "novelty," which is understood by participants to be tied to invasive species, is perceived to threaten what parks are for which is to conserve native biodiversity and representative ecosystems. Moreover, some participants were concerned about the amount of energy that was being put into developing concepts such as novel ecosystems, and would rather that energy be used for developing genomic technologies such as CRISPR that could potentially help eradicate invasive species. It is interesting to note that a participant was excited about the potential of CRISPR genomic technology which is arguably a very strong intervention in ecosystems, albeit with an effect that is perceived as favourable which is reducing invasive species.

Standish et al. (2013) shed light on two categories of concerns that they anticipated people would have to the novel ecosystem concept. The first category is misapprehensions that will arise from lack of complete knowledge about what the concept means, particularly around invasive species and the fear of doing nothing to mitigate them, and also fears of abandoning traditional ecological restoration and conservation activities. These misapprehensions were stated by most participants and are summarized rather succinctly in this quote, "If you were to tell me that the way to go forward is just novel ecosystems, then I wouldn't do anything for restoration,

right? I would just go, well fine, then it's all just going to be novel, and we'll just let it play out the way it wants to play out" (P13). If the concept was ever to be introduced into Parks Canada's restoration policy, misapprehensions would need to be adequately addressed by opening up discussion and clarifying what the novel ecosystem management framework means for invasive species and restoration (Standish et al., 2013).

Persistent concerns are tangled up with people's values and belief systems and can lead them to view novel ecosystems as deeply "troublesome" and as such are harder to address (Standish et al., p.300). Persistent concerns described by Standish et al. (2013) include whether people will care as much about novel ecosystems as they do about native ecosystems, whether the concept will add unwanted complexity into managing ecosystems, and whether novel ecosystems will threaten the humility needed to exert restraint while managing ecosystems, and thus steep us in hubris. Participant's concerns about novel ecosystems threatening the representative ecosystem mandate of Parks Canada falls in the category of persistent concerns because they are perceived to threaten the "natural heritage value" (p.301) of these representative regions (Standish et al., 302).

Standish et al. (2013) cite Egler's maxim that "ecosystems are not only more complex than we think, but more complex than we can think" (Egler, 1977, as cited by Standish et al., 2013, p.300). This echoes what one of the participants said, "Ecology is not rocket science, it's just so much more complicated than that" (P5). Standish et al. (2013) state "A distinct advantage of developing a conceptual framework for the management of novel ecosystems is that such a framework must acknowledge that ecosystems are dynamic and complex" (p.300) rather than static. The merits of the concept for ecological restoration practice are that it offers flexibility in restoration options when limited resources are the reality (Hobbs et al., 2013). However, Parks

Canada has a method of prioritizing scarce resources through their ecological integrity program; similar to criticisms of the novel ecosystem concept by Murcia et al. (2014), one participant said in relation to having to prioritize where scarce resources go, “we do [that] just by nature” (P9). Parks Canada also already recognizes that ecosystems are dynamic, the Parks Canada State of the Park report from 1997 acknowledges that “Ecosystems are inherently dynamic and change does not necessarily mean a loss of integrity. Systems with integrity may exist in several states, but the change occurs within acceptable limits...” (p.23). As discussed in Chapter 2, The challenge for parks according to Lemieux (2016) will be to determine the degree of change, or novelty, that falls within “acceptable limits” (p.434).

This kind of thinking about novel ecosystems diverges from where many parks scholars are saying the conversation needs to go under pressures of global change (Lemieux, 2016; Hagerman & Satterfield, 2014). Prominent park scholars in Canada are affirming that novel ecosystems will be a reality at some point (Lemieux, 2016). In fact, Lemieux (2016) goes so far as to say park managers should ensure “that the novel ecosystems that emerge are also diverse and resilient” (p.439). Furthermore, system planning as it currently exists, focussed on representative ecosystems, is already vulnerable to climate change impacts: “37 to 48 per cent of Canada’s Protected Areas (Pas) could experience and change in terrestrial biome type in response to conditions in which the concentration of atmospheric carbon dioxide (CO²) has doubled since the beginning of the industrial revolution around 1750” (Lemieux & Scott, 2005, as cited by Lemieux, 2016, p.431). This information suggests that parks ought to be more engaged in conversations around these inevitabilities.

In an effort to broaden the conception of novel ecosystems, Heger et al. (2019) embrace “ecological novelty” as an umbrella term that is descriptive rather than value-affronting and

considers ecological as well as evolutionary processes. They offer up a research tool that can hopefully encourage productive discussions around how to manage inevitable novelty emerging from fine to coarse scales. Heger et al. (2019) argue that it is helpful to study novelty from a site-specific or an organism-centered perspective. For example, if bull trout is moved to creeks it has never existed in before, from an organism centered perspective it may be experiencing evolutionary novelty and studies could focus on the degree of novelty and associated impacts the organism is experiencing in its new environment. I used the terms novel ecosystems and ecological novelty in asking my question to participants, and in all their answers they referred to them as novel ecosystems suggesting they are less accustomed to the term ecological novelty.

In sum, participants had misapprehensions and persistent concerns about the novel ecosystem concept. Misapprehensions include fears of giving up on invasive species, and persistent concerns relate to abandoning Parks Canada's vision for the systems plan. Indications from literature in recent years (Hobbs et al., 2013; Lemieux, 2016; Hagerman & Satterfield, 2013; 2014) suggest parks will need to grapple with these concerns sooner or later to be able to meet the challenges of global change and conserve biodiversity. But so long as the conversation is stalled by misapprehensions or persistent concerns, valuable time to determine an action plan is wasted. The framework described by Heger et al. (2019) could be a path forward for parks and protected areas to understand how novelty may be manifesting on the landscape, to open up discussion rather than shutting it down, and to inform decision making.

Findings from the interviews suggest there is still much uncertainty and no clear path forward for adaptation to climate change in WLNP. However, participants said it is becoming more a part of the conversation both in the park and nationally with the series of workshops that were held in 2020 (Nelson et al., 2020). This finding is not surprising given that climate change

adaptation has consistently been cited by park managers in studies to be more of a concern for the future rather than today's more pressing issues of protecting endangered species, managing invasive species, external threats, and patterns of human land-use (Barr et al., 2020; Lemieux et al., 2011a). These priorities were discussed widely by participants, for example, a participant said "I think right now our biggest challenge is invasive species" (P13). Additionally, protecting endangered white bark pine, fescue prairie, and bull trout, are high priorities.

Given that climate change has strong interacting effects with all these issues (Lemieux, 2016), and that climate change is stated to be a significant threat to human well-being and biodiversity by organizations like the IPCC (2018), it is somewhat surprising that climate change has not been integrated into management to a strong degree even though participants are well aware of this fact. For example, climate change is just one of four threats to endangered whitebark pine, but interacts with the other threat of mountain pine beetle (Carroll, 2004, as cited by Lemieux, 2016). Additionally, climate change is expected to cause widespread species redistributions (Scheffers & Pecl, 2019), some of which will be invasive, which will cause disruptions in predator-prey relationships, and may negatively impact endangered species, causing extinction or extirpation in some cases (Lemieux et al., 2016).

Even though park managers are aware of the realities of climate change, studies have shown that human capacity, financial resources and limited knowledge are significant barriers faced by protected areas in adaptation efforts (Barr et al., 2020). Barr et al. (2020) explained that there were significant federal budget cuts between 2006 and 2015 that impacted parks, and only in 2018 did funding return for environmental protection. The participants cited lack of capacity in many aspects of their work, especially in the wake of the Kenow fire, but they didn't cite it specifically relating to climate change adaptation. One participant said "the plan to be

intellectually aware and then to actually go through it are two different things” (P3) which suggests there is some lack of clarity, knowledge, or resources on how to proceed. On top of this, WLNP’s work is guided by the management plan, which is informed partly by public input (Parks Canada Agency, 2010). Climate change adaptation is fifth on the priority list for the public in Waterton (Parks Canada Agency, 2019b) which could be an added challenge to justify putting limited resources into. These data also point to differences in stakeholder opinions which has also been cited to be a barrier in the human dimensions of adaptation to climate change (Hagerman & Satterfield, 2014).

The Kenow fire provided some momentum for WLNP to consider climate change in a serious way now ecological integrity monitoring measures are being reassessed in light of impacts from the fire, and that the park will be able to study potential impacts from climate change as ecosystems naturally regenerate. “[The Kenow fire] has kind of been an impetus for us to start thinking about climate change....how....is that going to affect, you know, the post fire... recovery?” (P14). Importantly, it can be argued that allowing the post-fire landscape to regenerate as it will under this new climate is in itself a form of adaptation being embraced by WLNP: “We're letting...regeneration happen as it is going to happen under our current climate” (P4). Passive management in the way Waterton Lakes is applying it is a strategy for managers that are trying to encourage ecosystems to evolve under climate change (Lemieux et al., 2011b).

In conjunction with allowing natural regeneration, Waterton will use prescribed burning to maintain successional heterogeneity. A participant expressed, “It's more important than ever to get heterogeneity...patchiness and processes on the landscape” (P5) using prescribed burning. This strategy aligns with what Millar et al. (2007) argued to be a strategy for adaptation to climate change which is promoting “asynchrony” on a landscape scale after a disturbance. Millar

et al. (2007) state “Asynchrony can be achieved by promoting diverse age classes, species mixes, within-stand and across-landscape structural diversities and genetic diversity” (p.2148). Further, Millar et al. (2007) explain that early successional habitat is especially poised to adapt to current and future climate. Hessburg et al. (2015) similarly argued that restoring historical fire regimes that maintain successional diversity will not only ameliorate wildlife habitat, but will assist landscapes in adapting to climate change.

As a small park, WLNP is fortunate that it is embedded in the Crown of the Continent ecosystem which is in turn embedded in the larger Yellowstone to Yukon Initiative because these larger networks of protected areas help achieve their conservation goals (CPAWS, n.d.; Manners, 2016). Furthermore, the agricultural matrix outside WLNP is managed for biodiversity conservation and connectivity in partnership with the Nature Conservancy of Canada (NCC; Manners, 2016). Improving collaboration across broad geographical areas and jurisdictions, between Environmental Non-Governmental Organizations (ENGOS), government officials, scientists, the public, and land managers, is argued to be an important strategy in climate change adaptation (Heller & Zavaleta, 2009; Lemieux et al. 2011b). Waterton’s location in these larger landscape-scale conservation initiatives whose goals are to increase landscape connectivity is favourable because increasing connectivity is the number one strategy suggested in the literature for climate change adaptation (Heller & Zavaleta, 2009). These larger initiatives represent a paradigm shift to Ecosystem Based Management (EBM) rather than each jurisdictional boundary dealing with issues in isolation (Needham et al., 2016). However, even though WLNP is fortunate to be surrounded by, and to have strong collaborations within the surrounding protected area matrix, it is not a panacea. The rate of climate change will still limit some species

migrations and assistance will be required to translocate them (Lawler, 2009) which is illustrated quite saliently with the potential need for assisted migration of bull-trout.

One participant questioned the practicality and efficiency, given limited resources, of multiple jurisdictions such as Banff, B.C., and the U.S Forest Service, focusing on whitebark and limber pine restoration, asking: “is it worth putting a lot of effort into saving that species here in Waterton in particular?” (P2). There is a risk in reducing the number of actors involved in restoring these species because enhancing redundancy is a strategy to hedge bets in the face of climate change, according to Lawler (2009) and Millar et al. (2007). Though planting beyond the species’ range in WLNP isn’t possible because they are already at their elevational limit, the restoration program as a whole could consider planting these species outside their natural ranges and monitoring their success as a strategy to diffuse risk in case planting within its range is not successful (Millar et al., 2007).

A finding that emerged from my work was that there are areas of opportunity for Parks Canada to strengthen their post-emergency response. Large disturbance events like the Kenow fire may intensify under climate change, so there is an opportunity to further investigate the processes and structures that were in place after the Kenow fire in Waterton and what worked and what did not. Learning from their experience can help guide post-emergency response in Parks Canada, which was agreed upon by participants to be not as smooth and expertly addressed as emergency response for which Parks Canada is known.

As I described in my findings, participants lauded Parks Canada’s ability to manage emergencies while they are happening, but critiqued their ability to handle them in the aftermath. A participant commented that people don’t tend to plan for natural disasters like fire or floods, saying “If you have a business plan, it’s not in your business plan...So Parks needs to figure that

out, too.” (P2). Relating to the idea of incorporating this into a business or organizational plan, one participant praised the Burned Area Emergency Response (BAER) system that the US Forest Service uses to report on and stabilize immediate threats from wildfires as being highly efficient and organized. In the BAER there is a team of experts in vegetation, hydrology, archaeology, engineering, and other fields that are dispatched to the burned area to complete initial assessments and make recommendations for construction and restoration, often before the fire goes out. The purpose of BAER is to “determine the need for and to prescribe and implement emergency treatments on Federal Lands to minimize threats to life or property resulting from the effects of a fire or to stabilize and prevent unacceptable degradation to natural and cultural resources” (US Forest Service, n.d., para. 3). On this, a participant explained:

“They're working while the fire is still burning. They're already anticipating things they need to do and they are creating budgets....And then by the time the fire is out, they almost have a report ready to go. And then they do site assessments and then they complete it and then they're done. And it's a wonderful system, well structured. And I sent that around after the fire and I think it just fell on deaf ears” (P9).

Implementing a system like BAER at the federal agency level could reduce the stress that staff feel as they have to step into different roles to manage an emergency.

The Kenow fire was a challenging experience for many people working in the park. As one of the participants mentioned, carrying out the Critical Incident Debrief to address the immediate psychological and emotional needs of individual staff fell on their shoulders when they had little training in that area. Ongoing stress for many participants was rooted in workloads that doubled or tripled overnight. Further, delays in funding added a challenge in ensuring people were hired on time to help manage the workload. This, along with high staff turnover in one department, added to the work that needed to get done. English (2018) outlined their experience

with how Parks Victoria (Australia) has dealt with Critical Incident Stress (CIS), or trauma, experienced by park staff in having to respond to things like wildlife and human mortality or large natural disturbances such as wildfires, on top of other potential work stresses like workloads and funding uncertainties. Similar to what I heard about the Kenow fire, English (2018) explained that dealing with CIS usually fell on the team of staff in the park itself, often with little training or adequate external support. English (2018) writes that staff in parks have to “constantly re-engage with the original event” through rebuilding infrastructure, as an example, which takes years to accomplish, and that “the landscape itself can bear the scars of an incident for a long time” (p.10) which can have long term consequences on park staff. This was felt by one participant, recall them saying “I’m happier not being there and seeing it” (P1).

English (2018) noted that critical incident trauma was never part of Parks Victoria’s dialogue and that discussions around health and safety usually focussed on physical injury and not mental health, though that is changing. Importantly, English (2018) highlights the fact that parks are often seen and advertised as places of refuge and healing from stressful lives in the city, but that people must also realize they are workplaces that people are responsible for at the same time (p.12). This narrative can be found on Parks Canada’s Science and Conservation website. As part of their #NatureForAll campaign, “Mood Walks” are planned in Rouge Valley National Park to support mental health among the public. On the Mood Walks website a quote by naturalist John Burroughs is showcased, “I go to nature to be soothed and healed” (Parks Canada, 2019e).

The Canadian Government offers Employee Assistance Services (EAS) including Critical Incident Stress Management and Psychological First Aid to federal employees in need (Government of Canada, 2019b). While stress was high, many participants commented on the

fact that a lot of support was available from the Federal Agency and the team in Waterton was supportive to one another throughout the fire and in the aftermath.

Conclusion of Chapter

I recall walking on the beach in the Waterton Lakes townsite while I was there in March 2020, and down by my feet the majority of tiny driftwood pieces scattered among the rocks were charred. It was a moment of pause and reflection on just how much a fire changes a landscape. In concluding this chapter, I will first reiterate that the significance of this fire is largely a result of the fact that there were threats to public safety and built infrastructure, and that many larger fires happen all the time that aren't reported on in the media because they don't pose equivalent threats. With that being said, the Kenow fire was still exceptional in its uniform high severity impacts and its unusual fire behaviour. It was the first time that an entire park and townsite had been evacuated in Parks Canada's history.

It was intellectually understood by staff that something like Kenow could happen eventually because fire is a natural process in the landscape and there hadn't been a stand replacing fire in recent memory. Even still, the Kenow fire took everyone off guard. I conducted my interviews in March of 2020, just as COVID-19 infections were rising around the globe. The emergence of this unexpected event in our lives, that humanity intellectually understood has happened and likely would happen again, is a compelling analogue to the Kenow fire, though on much, much larger scale. The impacts of extreme events are hard to imagine fully until you live through them.

The impacts of the changed landscape affected people working there on personal levels. Some participants described feelings of grief and disorientation returning to places they knew

that had been so radically transformed. There was a lot of stress and worry about increased workloads and getting projects completed, and how the landscape would regenerate after such an event. This was all tempered with a strong excitement over the incredible opportunity to learn about post-fire renewal in a time defined by climate change.

The fire opened up opportunities for more ecological restoration activities in the form of prescribed fire and whitebark and limber pine restoration. There is also a strong, continued focus on invasive species management. There are no plans for planting native species in the burned areas, or even more southern adapted species, as some scholars have suggested is a restoration possibility after disturbance events. The park is still in a wait-and-see phase, allowing nature to take its course, and taking a more passive approach until they understand what vegetation is coming back. As my findings showed the fire did not impact the way people working in WLNP approach restoration in any major ways, but rather, amplified the restoration projects they had underway before the fire.

Climate change adaptation at an organizational level is only just beginning to take shape, but it is still unclear as to what shape it will take. This lag in adaptation is in alignment with what studies have shown, in that adaptation is seriously hindered by lack of institutional capacity, too much scientific uncertainty, and conflicting opinions of stakeholders, among other issues. While many are calling for parks, and conservationists more broadly, to start seriously discussing climate change options that are more unconventional such as assisted migration, conservation triage, and novel ecosystems, my findings showed that there is still reluctance to look at these options. This is especially true with emerging ecological novelty, as I prefer to call it, and not so much with the case of assisted migration in WLNP. As Hagerman & Satterfield (2014) noted, so

long as we are unwilling to have serious discussions about how priorities will be set under these inevitabilities, valuable time is being wasted.

It can also be argued that allowing the landscape to regenerate as it will under this new climate is in itself a form of adaptation being embraced by WLNP. They are adapting to climate change through restoring a more historical fire regime and heterogeneity on the landscape, and by allowing nature to take its course and adapt to the current climate. In this way, they are clearly open to change, by framing regeneration as renewal. Their management approach incorporates many valuable roles of history such as history as governor, history as legacy, history as redress, and history as reference, and ultimately, humility in deciding when to intervene (Higgs et al., 2014).

The conversations that led to the findings that were presented in this chapter centred around third-view photo sets from the Mountain Legacy Project collection. In the following chapter I present findings on how repeat mountain photographs in photo-elicitation worked as a method in this context and discuss challenges that arose. In Chapter 6 I synthesize findings from both chapters and provide recommendations for future research.

Chapter 5: Findings for Evaluation of Photo-Elicitation Method using Repeat Photography

As I described in Chapter 2, photo-elicitation as an interviewing method has scarcely been used in a National Park context, especially using third-view repeat photograph collections. In this chapter I present and discuss my findings for my second research question, which has two parts. The first asks: what are the broader themes, and specific issues, that third-view repeat photography can elicit from ecological restoration and park management, and how do participants engage with the photos? The second part of my research question is: in what ways is photo-elicitation an effective method in park management research? I will present my findings on broader themes and specific issues that were elicited first. This will be followed by relevant findings relating to all photo-elicitation codes that I used in data interpretation that pertained to participants' experience with the method. In my discussion I integrate these findings and compare them with other researchers' experiences using photo-elicitation to offer insights on what worked well and where there were challenges.

Findings

To enable me to understand what the broader themes and specific issues the photos elicited, I used the code co-occurrence tool in ATLAS.ti, as described in Chapter 3. This tool allowed me to see the number of times that each of my codes overlapped with each photo year (1914; 2004; 2019). When a code overlapped with a photo year, that means the participant was

talking about that theme or issue while looking at the photos. Initially I included all the codes in the code co-occurrence analysis. However, for the purpose of simplicity and to only highlight the themes that occurred most often, I did not include in Table 5.1, below, those codes that co-occurred less than ten times with the photo-elicitation codes. Additionally, throughout the coding process I became aware that most of the codes pertaining to “Cultural Resources” which included indigenous history, archaeology, and settler history, were attributed to one participant who worked in cultural resources. In my first code co-occurrence analysis that included all participants, the aforementioned codes were some of the most numerous, especially for the historic photo year. I excluded that participant from the code co-occurrence analysis to get a better understanding of what people who worked in resource management were saying, and these results are in Table 5.1. You can see that the aforementioned codes are no longer among the themes with the most co-occurrences. This participant’s voice was still included in the study and in this chapter, as I do discuss other codes that are not in Table 5.1 and simply wanted to showcase the codes spoken about most often by resource conservation.

Table 5.1 shows the 9 codes that had the highest co-occurrences with the photo-elicitation codes for the three photo years (1914; 2004; 2019). The 1914 photos were coded 125 times, the 2004 photos 101 times, and the 2019 photos 160 times (Table 5.1). The 1914 photos elicited themes around natural disturbances other than fire such as the bark beetle epidemic, the 2013 flood event, and blowdown effects relating to standing dead trees. The 1914 and 2004 repeat photos also had high occurrences of the issue of vegetation encroachment, most often while being compared with one another: “So this is interesting....these meadows you can see in the early 1900s...compare them to [2004]...they're getting a lot more encroached” (P11). Prescribed burning was also discussed often while looking at all the photos, which I will discuss later.

Table 5.1: Findings from code co-occurrence analysis showing codes that co-occurred greater than ten times with the photo-elicitation codes (see Chapter 3) for each year (1914; 2004; 2019) highlighted in grey, codes that co-occurred less than ten times are white. ‘Gr’ signifies the ‘groundedness’ of the code, and denotes how many quotations in total were coded with that particular code (Gr: 1914:125; 2004:101, 2019:160).

| Code | Photo-Elicitation: 1914 <i>Gr=125</i> | Photo-Elicitation: 2004 <i>Gr=101</i> | Photo-Elicitation: 2019 <i>Gr=160</i> |
|--|---|---|---|
| ●Climate Change: ecological effects <i>Gr=45</i> | 8 | 7 | 10 |
| ●Ecology: encroachment <i>Gr=29</i> | 17 | 19 | 8 |
| ●Ecology: other disturbance <i>Gr=31</i> | 11 | 16 | 16 |
| ●Kenow: ecological impacts <i>Gr=55</i> | 9 | 7 | 23 |
| ●ER: prescribed burn <i>Gr=51</i> | 9 | 11 | 16 |
| ●Kenow: fire behaviour <i>Gr=47</i> | 2 | 4 | 21 |
| ●Kenow: renewal/regeneration <i>Gr=59</i> | 8 | 8 | 27 |
| ●Photo-Elicitation: other snapshots <i>Gr=30</i> | 9 | 6 | 12 |
| ●Photo-Elicitation: personal narrative <i>Gr=29</i> | 7 | 6 | 15 |

When participants were looking at the 2019 third-view photos, comments were most frequently regarding vegetation renewal, or regeneration, followed by Kenow fire’s behaviour and ecological impacts. For example, many participants commented on how the fire entered the park over the divide, as seen from photos on Festubert Mountain (Figure 5.3). “Outside the park to the right of the image here on the burned image, you can see...areas that didn't burn. So the fire was sort of moving down the valley...then taking runs up towards the divide” (P2).



Figure 5.1: Arthur Wheeler's 1915 photo from Festubert Mountain (Photo number: 4-2 [16]).



Figure 5.2: 2004 repeat of Wheeler's 1915 photo from Festubert Mountain, taken on August 5th, 2004, showing some vegetation encroachment over the past century (Photo number: B0012P0189).



Figure 5.3: Third-view taken on July 15th, 2019, from Wheeler’s 1915 station on Festubert Mountain which elicited many comments about how the fire came over the divide. Regeneration is patchier here, and there are more barren patches, compared to the lower elevations (Photo number: DSCF3912).

Participants often commented on where the fire stopped burning which is seen from Lakeview Ridge (Figure 4.15 in Chapter 4) and Avion Ridge (Figure 5.4), and also how the fire stopped at the edge of the town as is shown from the Cameron Bend station (Figures 4.1, 4.2, 4.3 in Chapter 4). Figure 5.6 shows the 2019 repeat photograph from Blakiston Divide that elicited many comments on fire behaviour. That photo shows different fire intensities (lower fire intensity is evidenced by the red needled trees) and it shows how the fire moved up the Blakiston Valley and where it eventually stopped.

“So all the burn that you see in this valley was actually back burned, so it's burning against the wind basically, which means it's usually less severe...and then....where it....started getting snow and cooler conditions...it just kind of put itself out” (P14).



Figure 5.4: Historical panorama from Bridgland's Blakiston Divide Station #87. Created in Photoshop by Cassandra Buunk (Photo numbers: BRI1914_B14-575 [Left], & BRI1914_B14-580 [Right])

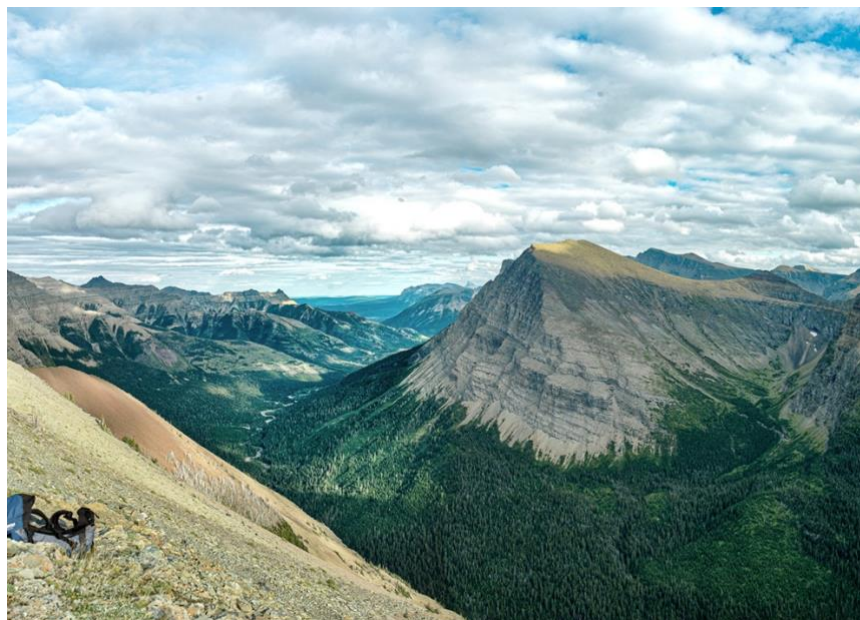


Figure 5.5: 2004 repeat panorama from Bridgland's 1914 Blakiston Divide Station #87 (Photo numbers: B0014P0042 [Left] & B0014P0041 [Right]).



Figure 5.6: Third-view panorama of Bridgland’s 1914 Station #87 on Blakiston Divide, highlighting fire behavior patterns visible in the burned and unburned forest. The trees with red needles likely burned at a lower intensity that did not consume all needles as it did in the forest in the rest of the photo (MLP, July 13th, 2019; Photo numbers: DSC_6756 (Left) and DSC_6760))

The 2019 photos elicited the most comments about renewal, as green understory vegetation was visible in many photos. In particular, many commented on how incredible the wildflower display was, which was shown in the 2019 photo from Blakiston Mouth (Figure 5.9).

“Coming out of a time when we weren't sure how things were going to look...if there would be this sort of regrowth...that's pretty impressive for two seasons worth of regrowth following such an extreme disturbance” (P7).



Figure 5.7: Bridgland 1914 Station #98 from Blakiston Mouth. Historical trails are visible in the grassland (Photo number: e004414487).



Figure 5.8: First repeat taken July 28th, 2004, of Bridgland's 1914 Blakiston Mouth Station #98 by the MLP field crew. This photo shows aspen encroachment over the past century. (Photo number: B0012P0135).



Figure 5.9: Third-view of Bridgland’s 1914 Station # 98 from Blakiston Mouth, taken July 11th, 2019 by MLP field crew. Many participants commented on how prolific the wildflowers were following the Kenow fire. (Photo number: DSC_6737).

The 2019 photos also elicited comments about the ecological effects of climate change. For example, one participant spoke of the potential for streams to heat up now that they are so exposed which could put cold water fish such as bull trout more at risk. Participants also commented that unpredictable weather may threaten newly established seedlings in the coming years and that whitebark pine may have nowhere to go. While looking at the photos of Anderson Mountain (Figures 4.10, 4.11, 4.12 in Chapter 4), a participant commented on potential impacts of climate change on forest growth, and used the historic photo as an example of what the landscape could transition to:

“Last year was actually...a good year for precipitation...and for seedling regrowth....but it would be easy enough for a drought to come through here and wipe out those really sensitive little seedlings....And then we could see some of this stuff transition from a forested landscape to...grass or shrub land....More...like what we see here” (P2).

Similarly, when viewing the Blakiston Mouth photos (Figures 5.7, 5.8, & 5.9) another participant commented on how natural successional change from grassland to forest might be disrupted with climate change:

“Probably a previous fire opened up this landscape, it grew up, and then fire has returned it back to what it was 100 years ago....But...I’m not convinced that this cycle is going to be able to continue....with climate change....Those forests...may not come back...then climate change will exacerbate everything and there's not much we can do about that” (P9).

While looking at Lakeview Ridge (Figures 4.13, 4.14, & 4.15 in Chapter 4) a participant commented on how much work has gone in to reducing aspen encroachment in the fescue prairie over the years, but that climate change may do the work for them eventually: “We don't have to actually be doing any of this. All the [climate] models show us [that] aspens are going to go away anyway; it'll go back to grasslands” (P1).

Many participants talked about a personal experience they had, which I had coded as “Personal Narrative,” in the areas shown in the photos, such as a hike they went on, and things they saw or felt. For example, when looking at Anderson Mountain (Figures 4.10, 4.11, 4.12 in Chapter 4), a participant offered a memory:

“I went for hike up the Blakiston trail here... it was almost like monocultures of a single wildflower for kilometers. You’d...be walking through blackened forest with yellow flowers all around for a while until you get up to the Kootenay pass area, and then.... you hit a certain elevation and the regrowth just hadn't gotten there yet” (P6).

As Table 5.1 showed, the only restoration category that had a higher number of co-occurrences with photo-elicitation was prescribed burning. Participants commented on areas that had received, or were going to receive, prescribed burning to kill aspen stands and restore fescue prairie. For example, the following comment about prescribed burning in the Red Rock Valley was from when a participant was looking at the photos from Blakiston Divide (Figures 5.4, 5.5, & 5.6):

“In previous years, in 2015 or 2016, we did a big one, we burned probably from here all the way down around the corner... but even with that... the fire still roared through Red Rock so severely that...for...that next year after the fire... [it] was still completely black...there was nothing left all the way up both sides of the valley...to the ridge top” (P14).

A participant used the 2004 and 2019 photos from Anderson Mountain (Figure 4.11 & 4.12 in Chapter 4) to explain that the risk for a prescribed burn would have been too high in the past, but that now they might be able to do more prescribed burning and return a historic fire return interval:

“It would be incredibly difficult to control something that was lit back here or around here or anything else like that. But if you've taken away all the overstory, and you're dealing with a forest structure that's three feet tall, not 70 feet tall, it's much easier to control” (P2).

This participant used the photos to illustrate their point after I had asked them a question about the implications of potential reduced forest regeneration under climate change. Table 5.2 shows the remaining ecological restoration codes and how often they co-occurred with the photo years.

Table 5.2: Code-cooccurrence analysis results for the ecological restoration codes other than prescribed burning. “Gr” denotes the number of times that code was used in total across all transcripts.

| Ecological Restoration Code | Photo-Elicitation: 1914 | Photo-Elicitation: 2004 | Photo-Elicitation: 2019 |
|---|-------------------------|-------------------------|-------------------------|
| ●ER: aquatic <i>Gr=22</i> | 2 | 2 | 6 |
| ●ER: baselines <i>Gr=14</i> | 2 | 1 | 1 |
| ●ER: fescue <i>Gr=27</i> | 4 | 4 | 2 |
| ●ER: historical fidelity <i>Gr=23</i> | 7 | 3 | 6 |
| ●ER: invasive species <i>Gr=81</i> | 1 | 2 | 3 |
| ●ER: novel ecosystems <i>Gr=34</i> | 2 | 1 | 1 |
| ●ER: reintroduction of species <i>Gr=5</i> | 2 | 1 | 1 |
| ●ER: seeding/planting <i>Gr=25</i> | 2 | 3 | 3 |
| ●ER: whitebark/limber pine <i>Gr=31</i> | 4 | 5 | 9 |

Whitebark and limber pine restoration was discussed more so than other restoration issues, co-occurring 9 times with the 2019 photos. Four of those occurrences were from one participant. When looking at the photos from Festubert Mountain (Figures 5.1, 5.2, & 5.3) a participant commented on how they lost a lot of trees that were thought to be resistant to white pine blister rust, and that they lost a lot of newly planted seedlings. They also said that the fire created opportunities for restoration: “In these back areas it did open up opportunities for more planting...usually we try and plant in burns because it significantly increases their chances of survival, the seedlings” (P4). When participants commented on aquatic restoration while looking at the photos, it concerned standing dead trees that could fall into the creeks; the effects this may

have on habitat, and the impacts of changing stream temperatures from no overstory vegetation.

In one case a participant talked about Kessler Lake, visible in the Lakeview Ridge photos (Figures 4.13, 4.14, & 4.15 in Chapter 4). They mentioned that it is now full of introduced brook trout and that they may want to restore native species:

“It used to be a bull trout stronghold. This is one of the creeks we're assessing whether we can do something to bring bull trout back or whether it's one that we could put in West-slope cutthroat trout which have been...extirpated from the park” (P9).

In another instance, reintroduction of species was discussed when looking at the photos from Bridgland's 1914 Anderson Mountain station (Figures 4.10, 4.11, 4.12 in Chapter 4), and it concerned reintroducing bison in WLNP. A participant said:

“I would have expected more evidence of bison on the landscape and... I'm just not seeing it on pictures like this....We're actively trying to bring bison back onto the Waterton landscape in partnering with the Blood Reserve as part of what's called the INNEI initiative....I often wonder whether Waterton was just used as a kill site or whether it was actually bison habitat....it's...hard to envision that in some of the historic shots” (P13).

When a participant commented that the 2019 landscape looks like the historic landscape, I coded it as “historical fidelity.” For example, participants said “It actually looks closer now to what it used to look like then” (P11) and “The photo from ...after Kenow looks...more like the photo from the...1900s than the photo in the middle” (P6). In one case a participant discussed ecological integrity and historical fidelity, saying “If I can make [this] park resemble this historic shot, emphasis on the word resemble, then I think I'm meeting my EI targets” (P13). The ecological restoration codes that were not mentioned in relation to the photos were “disturbed site/gravel pits” and “restoration success.”

The “Other Snapshots” code highlighted any instance where a participant discussed something that was just outside the photo frame, or other photos they had seen earlier in the interview or elsewhere, and had a relatively high co-occurrence with the 2019 photos. Half the occurrences were attributed to one person who knew the Mountain Legacy Project photo collection and other historical photo collections from the region well. For other participants, some wanted to see intermediary photos between time periods, or prior to the first historical photo: “It would have actually been interesting to see this view, like between here and here [points to 2004 and 2019], just to look at the difference that the prescribed fires were making” (P7). Some participants referred to areas just outside the photo: “Y camp is a unit that...we’ve burned a number of times and we’re going to burn it again this spring. I think...it’s just up here, just out of the photo. That would have been interesting” (P11).

While many participants commented on visible changes in the photos, many participants mentioned that they weren’t seeing a lot of change. For example, two participants commented on how the aspen stands visible in the Lakeview Ridge photos in 1914 haven’t changed much over time:

“But the expansion of the pattern of aspen is interesting in this because there isn’t a huge change, there’s a change in density...in between the original and the repeat but...up on this slope here there hasn’t been a lot of spread” (P8).

Some commented that landscape change in the decades before the 1914 photo was taken was probably more dramatic than that shown after. One participant remarked, “I was thinking [that] my family homesteaded here in the late 1880s...that’s, like, 40 years before this picture...I can’t imagine the change in 40 years” (P10). The historical Blakiston Mouth photo (Figure 5.7) in particular contradicted what one participant would have thought the landscape looked like:

“I would love to see an earlier photograph... The verbal descriptions of those early people going up and over these passes indicates that it was way grassier, and then the sheer volume of bison in this valley, historically, like what were they eating, right? But when you... go to these modern repeat photographs...there's not a heck of a lot of difference. And I'm astounded by that, just because it's at odds with what I was thinking” (P3).

In speaking about the fixed quality of the mountains in the photo sets, a participant reflected that: “When you’re on the ground it seems so dramatically different, but from a high view... it’s not that impacting... they’re not vegetated, so most of it is still just bare rock like it was before” (P1). Likewise, another participant remarked:

“Maybe it’s not as dramatic as we think on a local level, and maybe it’s just sort of a human response that we’re experiencing, but when you look at it over the past hundred years...it doesn’t look that different.” (P13)

Regarding the appearance of the photos, some participants struggled to determine vegetation in shadows: “Did that actually burn here? Or is that a shadow? I'm pretty sure that's all burnt, it is just a cloud shadow” (P2). In a similar vein, some participants commented on the colours in the photos and how they look more vibrant than what the naked eye would see: “I think the images...somehow look a bit greener than I remember it looking” (P7). Another participant pointed out that the coloured roofs in the town look redder in the pictures than in real life and went on to talk about how public opinion is divided on whether they like or don’t like the roof colour. Often, the historical photos will have blemishes that are particularly noticeable in the sky, as one participant noticed, “Another view the Blakiston Valley, how come this one is so grainy? Is it just the technology back then or just a dirty lens?” (P6). Another participant commented on photo set that is in portrait, “It's a little bit different having them in portrait then landscape, that's for sure” (P13). Finally, the large size prints enabled some participants to see things they hadn’t seen before, “I never noticed that on the smaller versions” (P7).

Many participants had trouble orienting themselves and figuring out which mountain the pictures were taken from or looking at. There was a map in the room that many participants often used to orient themselves before commenting on the photos themselves. “I’ve never...walked this ridge or anything... it’s hard for me to place this photo, it’d be helpful if you had a map” (P5). Some participants wanted to know whether the photos were taken at the same time of year, especially with photos that showed more change such as Blakiston Mouth: “are these really the same time of year?” (P11).

Though I didn’t include the cultural resources participant in the analyses shown in Table 5.1, the photos elicited rich information on the storied past of the landscape in Waterton Lakes. The photos from Cameron Bend (Figures 4.1, 4.2, 4.3 in Chapter 4), for example, show Chief Mountain in Glacier National Park in the US poking up in the distance. This made one participant think of the Indigenous peoples’ practice, particularly the Blackfoot and Kootenay, of vision questing: “This is a sacred landscape that we’re all on... Most Indigenous groups consider the... Waterton-Glacier area as a sacred landscape. And because of that, every high spot... that has a good view of Chief mountain or some other...sacred mountain like it... they had vision questing going on” (P3).

I finished the interviews by asking participants what was missing from the photos. Most participants quickly said humans and wildlife were missing. Participants additionally said that it was difficult to see things like chemical composition of creeks and jurisdictional boundaries, and difficult to capture things like the sound of being in the burned area. Many also commented that the photos are coarse scale rather than fine scale: “There’s a lot going on on the ground...in every little square centimeter of these photos so...you’re not looking at the detailed processes happening on the ground” (P7). Another participant said “I...want to zoom in a little bit and see

things a little closer like...what is that plant there?” (P-4). Similarly, another participant commented about the vegetation regrowth shown in the Blakiston Mouth photos (Figure 5.9): “When you look at it from a low angle, it looks like it's all grown, and if you look at it straight down, it's obviously not growing in there's lots of bare patches” (P2). A participant said the fine scale tells “a very, very different story than at a big scale” (P1). They elaborate, saying:

“I think at a big scale, the Kenow fire was...really neat. It was a natural process, and it's not a huge change. But I think when you get down to site specific stuff or species specific or valley specific... I think it's a different story. And maybe that's what's missing” (P1).

While I have outlined what people discussed when looking at the photos, a little less than half (six out of fourteen) of the participants did not have a lot to say, at least initially, which I coded as ‘awkward/unsure’. As I described in my methods, when I brought the photos out, I would give time and space for the participant to look at them, but for some participants they weren’t sure what to say or where to start. For example, participants said “I don’t know what you’re looking for” (P1), “...Is there something you’re looking for?” (P2), “I don’t know what else to tell you” (P11) or “...I’m not sure” (P4). This uncertainty was more apparent in the beginning of the interview, but as the interview went on the participants would generally comment on things they saw in the photos. I had told participants in my introduction to the interview that I was broadly interested in ecological restoration, and they had opportunities to read the consent form prior to the interview which also contained information on my research (Appendix B). In situations where a participant had low engagement, I would have to rely more heavily on asking questions as prompts. In one particular situation, after some discussion around what the participant was seeing in the photos, they said “I have more broad thoughts on the overall program direction” (P2) and went on to talk more about the park’s management response to the fire without using the photos. Another participant had little to say, unprompted by

questions, other than, “Yep, there's a natural disturbance” (P5) and “I’m just like, [there’s] more natural process [laughs]” (P5). The participant’s laughter and joking on how they weren’t good at photo-elicitation helped break the ice. That same participant said that the photos I had shown them so far weren’t in ecosystems they worked in, so I showed them one of an ecosystem they worked in and they had more to say, unprompted by questions. They said, “You could tell where I’ve done work because I’m like, I know all about this one....it shows how people connect differently” (P5). A similar situation occurred with another participant, where they had a lot to say with photos that showed ecosystems they worked in and not as much to say otherwise.

As Table 5.1 shows, the themes that were discussed most often using repeat photographs in this context were concerning natural disturbances, prescribed fire, vegetation encroachment, ecological effects of climate change, the Kenow fire’s behaviour, effects, and renewal, and participant’s personal stories. More specific issues elicited included seedlings of whitebark pine being killed by the fire, causing restoration setbacks; increased opportunities for using prescribed burning as a restoration tool; and climate change impacting how the landscape will regenerate after the fire. The photos did not elicit anything on topics of governance; resources (eg. funding, non-monetary); criticisms of how the park handled the fire; balancing dual priorities; work being busy; collaboration with other jurisdictions, landowners, researchers; as some examples. Participants discussed ecological restoration issues other than prescribed fire while looking at the photos, though more infrequently, as Table 5.2 shows. In the following section I will discuss the benefits and challenges of photo-elicitation using long term repeat photographs in this research context.

Discussion

My findings showed the specific themes and issues that were elicited most often while looking at the photos, how participants engaged with the photos, and where there were some challenges with the method. For my discussion I will discern possible explanations for why the photos worked in some cases and not as well in others. In considering all the information presented I will attempt to answer my second research question asking: in what ways is photo-elicitation an effective method in park management research?

In my first two interviews I was still calibrating how I was deploying the photos in the interview. As I brought out a new photo set, I would ask a question, and the participant's attention would focus on the question rather than the photos. Upon consideration on how this process was working I decided that I needed to refrain from asking my questions and give participants enough "space for reflection" (Tinkler, 2014, p.5) while looking at the photos. Many participants engaged well with the photos and they facilitated easeful conversation, offering opportunities for me to ask my questions. If the conversation naturally flowed into a topic that I had a question about, I would take the opportunity to ask it, as photo-elicitation is about fostering natural conversation between researcher and participant. In this kind of circumstance, where conversation flowed easily I would ask any remaining questions I still had after we cycled through all the photo sets.

Much of the information that was elicited was of a more encyclopedic quality (Lapenta, 2011), describing what participants saw in the photos such as natural disturbances, fire patterns and effects, vegetation regeneration and encroachment (Table 5.1). There were also instances where what participants described in the photos led to them commenting on how they personally

thought about various issues regarding park management and restoration. Some examples where the photos brought up interesting comments on park management are as follows.

When I showed a participant the Blakiston Mouth photos (Figures 5.5, 5.6, & 5.7) and they commented on forest succession, saying, “I’m not convinced that this cycle is going to be able to continue....with climate change” (P9), that afforded me an opportunity to ask them about how climate change is considered in their restoration work. That led to me finding out they did not have a clear plan for climate change adaptation in their restoration efforts, but that they were brainstorming, attending workshops, and had some ideas about what to do. This is an example of a moment where a participant naturally expressed their own thoughts and feelings rather than simply stating what they saw in the photo. In another example, when I asked a participant about the implications of reduced forest regeneration under climate change, they used the photos to illustrate their point about being able to use prescribed burning to restore a historical fire return interval which maintained a more open, less forested landscape. They said, “If you've taken away all the overstory, and you're dealing with a forest structure that's three feet tall, not 70 feet tall, it's much easier to control” (P2) prescribed burning. In this case the photos were able to elicit conversation around specific fire management plans for the future of the park. In another instance when a participant talked about how aspen would be naturally reduced by climate warming in the future, this, too, offered a glimpse into this participant’s line of thinking on management direction in the park.

With 6 of the 14 participants, I had to rely heavily on my questions to prompt conversation because the photos were not eliciting conversation on their own. There was an awkwardness and uncertainty over what to say or what I was looking for. While I anticipated some participants to feel nervous, reserved, or not engage with the photos, on the whole this was

unexpected because one of photo-elicitation's purported advantages is to reduce the awkwardness that a formal interview can have (Lapenta, 2011; Tinkler, 2014). Photo-elicitation is often used in interviews for the purpose of having rich, long interviews because the content of the photos provides ample talking points (Collier, 1957; Harper, 2002). However, Pauwels (2015) informs that "Not all material will have the same 'elicitation' potential for all respondents and the outcome will often remain fairly unpredictable" (p.99). There are several possible explanations for why it did not work as well with some participants.

Even though much consideration went into selecting photos, the content of the photos still may have been too obvious to some participants, as Tinkler (2014) suggests. Tinkler (2014) argues that participants won't have much to say if they believe the photos "require no explanation" (p.5) such as when one participant said "Yep, there's a natural disturbance," (P5) and didn't dig in further. Some participants had more to say when the photos showed the ecosystems they were more familiar with, so not all content was relevant to all participants. I tried to include full coverage of the parks eco-regions to account for this which turned out to be beneficial. On this point, I had sent the photos to participants prior to the interview so they could get familiar with the content and potentially think of some key points they wanted to discuss. However, most participants had not taken a look at them because they were too busy with end of quarter reporting. If they had reviewed them in advance it is possible they would have had more to say about them.

Other snapshots were mentioned quite often by participants, which were areas just outside the frame or other photos altogether that a participant had something to say about, which could not have been predicted. If those portions of the landscape had been visible perhaps I would have gained more information on specific sites, which may or may not have been useful in

answering my research questions. It is worthwhile to note that the photographs showed the landscape and some anthropogenic features like roads and the town, but they did not show the office building, nor inside it, where much personal experience and stress occurred after the fire happened, as Chapter 4 showed.

There were also instances where participants' perceptions of historical landscape change contradicted what they were seeing in the photos, specifically in relation to bison. Some participants expected to see more evidence of bison in the photos, and one said that there was much less grass in the photos than they had thought based on oral accounts – "I'm astounded by that, just because it's at odds with what I was thinking" (P3). von Hellermann (2020) states that there are "many different possible developments in the century that passed between when they were taken, and indeed earlier, and equally many different possibilities in parts of the landscape not captured by the camera" (p.382). I highlight this to reiterate that repeat photographs are only snapshots of one moment in time, and that while they show evidence of the reality in front of the camera, lived experiences and human memory are much more complex (von Hellerman, 2020).

Tinkler (2014) suggests that researchers using photographs must think about the context around photos "to understand their place in interviewees' lives" (p.23) because it may impact what people talk about when they are looking at the photos. Many participants knew of the MLP and could have contextualized it in their own mind as a research project with a specific research agenda. This could have translated into hesitation in talking about the photos at will, and instead asking me what I was looking for. In a similar way, it may have been the case that this type of interview was different than previous interviews participants had, so they may have been expecting to be asked questions rather than to talk freely about the photos. With this being said,

even in the interviews where the participant did not have high engagement with the photos there were still moments in each one where they used the photos to illustrate a point or where the photos created a jumping off point for conversation.

Personal narratives arose as one of the more highly elicited themes in Table 5.1 which suggests the photos were quite good at stimulating memories, as Tinkler (2014) argues. There were numerous instances where a form of personal narrative, or a memory, would arise when looking at the 2019 photos in particular, such as remembering walking through parts of the park before or after the fire. In the case of one participant where the photos didn't have much elicitation power, I suspect it was because this person was new to the park and thus did not have a long-standing relationship to the park ecosystems or any strong memories there. Table 5.1 showed that the 2019 photos elicited many comments on the impacts from the Kenow fire. That the 2019 photos were fruitful in eliciting on these specific issues makes sense as the fire is the most dramatic change shown in the photos and a recent lived experience for participants.

In general participants had less to say about the 2004 (101) photos compared to the 1914 (125) and 2019 (160). It is possible that the 2004 photos depicted a landscape so familiar to participants (Tinkler, 2014), having worked in that particular landscape for many years, that there was less of interest to discuss there. "Lack of change" was a photo-elicitation code I used because many participants commented on the lack of change between the 1914 and 2004 photos in particular. Fire suppression had been occurring prior to 1914 (Barrett, 1996), so it is possible that is why there was a lot of contiguous forest in 1914, as there was in 2004, contributing to the perception of lack of change and thus not as many comments.

As I explained in Chapter 3, all the photos were aligned and edited, and I tried to choose photos with minimal shadows. Klett (2011) discussed the fact that if photos weren't aligned

properly, or if they had different lighting and shadows, participants may focus on that rather than the changes in the photos. This occurred with some of the participants, for example, when they commented on photos that were portrait versus landscape, or how the clouds looked, but it did not occur often enough to obscure conversation around the content of the photos. In similar way, I assumed people would know where the photos were taken from, but that was an assumption based on my own experience. I had actually taken the photos myself and had visited these specific peaks, but participants took time to orient themselves. If a map had not been present in the room I am unsure how that would have affected the results.

Participants were asked what was missing from the photos because vantage points exclude other parts of the setting surrounding the photo (Klett, 2011). Furthermore, some phenomena are difficult to capture in photos, such as wind (Walsh, 2016) or butterfly migrations, as Smith (2014) discusses. Many participants talked about how the photos are at a landscape scale rather than a fine scale and that “you're not looking at the detailed processes happening on the ground” (P7). The office walls in Waterton Lakes were covered in fine scale photographs of renewal in action including wildlife, flowers and shrubs, and things like squirrel seed caches (Figures 4.5 and 4.6 in Chapter 4). Many participants are scientists and their work is more site specific, involving fine scale vegetation monitoring or removing invasive species. In this way, it is possible that including fine scale photographs such as specific invasive species, restoration sites, wildlife, or recreational sites such as the Crandell Campground, may have had different elicitation potential. Garrard et al. (2012) used repeat mountain photographs from Sagarmatha National Park, Nepal, to assess community member’s perceptions of how ecosystem services have changed over time. They assessed the efficacy of photo-elicitation in this context, and stated that while it was “very successful” in assessing ecosystem services there were “important

aspects of environmental integrity (e.g. supporting services)” and “dynamic relationships between ecological function” that were difficult to capture in photos which limited their results (p.28).

Participant-driven photo-elicitation, where participants take photos in their day-to-day life in the park, could have engaged some participants more in the interviews. For example, Walsh (2016) used MLP repeat photographs in photo-elicitation with fire lookout observers in Alberta. Many lookout observers showed her their own photographs of things like animal tracks, wildflowers, snow, clouds, and sunsets, and had more to say about those than the historical landscape photographs (Walsh, 2016, p.29). Tinkler (2014) writes that when participants discuss photos they’ve taken it has potential to draw out more of their personal meanings, feelings, and experiences attached to what is depicted in the photos; and it may open up dialogue on things the researcher didn’t even know to ask because participants may have access to things the researcher doesn’t. Another presentation of the photos with potential in future studies is digital. Klett (2011) presented his photos from his Third-View Project digitally and offered viewers a chance to zoom in and to use a feature called a time reveal window – a moving window around the photo that reveals what that portion of the landscape looked like in the past. In our digital culture it could have been a highly intuitive way of looking at photos, being able to zoom and pan around on a iPad, and could have added another “material dimension” (Tinkler, 2014).

Many of the photo-elicitation studies I found pertaining to the environment used it as a method to interview: i.e. farmers (Kong et al., 2015; Sherren et al., 2012); tourists (Groshong et al., 2018); or local community members (Berbés-Blázquez, 2012; Garrard et al., 2012). One study used participant driven photo-elicitation to understand both lay people and professionals (foresters) preferences relating to woodland landscapes in the UK (Dandy & Van Der Wall,

2011). The study involved site visits with participants to three woodlands followed by focus group discussion. Balsdon (2013) similarly motivated lay people and professionals to discuss photographs in interviews that showed various landscape types in a provincial park in Ontario to assess their values pertaining to ecological restoration. Falk (2011) interviewed park professionals using photo-elicitation in focus groups and interviews to understand challenges of managing and restoring remote mountain ecosystems. The reason for outlining this is because the participant group interviewed here is composed of professionals, experts in park management, and while there have been a few studies that have interviewed this particular group, most have not. Therefore, it is difficult to assess whether it was the group itself that did not work well with this method.

An additional thing to consider when thinking about whether the repeat mountain photographs worked well in this interview context is that it was my first time as a researcher interviewing others. My interviewing style and personal demeanour may have played a role in how participants engaged with the photos. There were moments where I could have directed participant's attention to the photos more explicitly while we discussed certain topics, but I too felt an awkwardness when the participant did not engage with the photos, and thus did not want to push them too much to say something.

Finally, throughout the interviews many participants commented on the value of these photographs and the ways in which they've been used by the park. For example, they have been used in presentations to the public to show that fire has always been a part of the landscape. They have also been used to help determine goals for prescribed burning and aspen reduction. And, of course, participants commented on their value in capturing in fine detail the Kenow fire's impacts: "These are incredible pictures to show this" (P10).

Conclusion

These findings showed what participants spoke of when they were viewing the repeat photographs, and the varied responses participants had with the content of the photos (e.g. high or low engagement). The sequence of photographs from three time periods (1914, 2004, and 2019) offered participants a look back over a century of landscapes changes. It is no surprise that participants tended to talk about landscape changes that are visible in the photos such as the Kenow fire's behaviour and impacts, vegetation encroachment, vegetation regrowth, and other natural disturbances such as bark beetle, blister rust, and flooding. Specific management issues that were discussed more often by participants were that of prescribed burning and the ecological effects of climate change. Additionally, the photos were quite effective at drawing out personal narratives from participants.

Participants enjoyed looking at the photos and in many instances participants had quite a lot to say about them. Despite this, I am hesitant to advocate that the presence of photographs in the interview added specific benefits to uncovering the findings that emerged in Chapter 4. There were occasions where participants went beyond describing what they were seeing in the photos to stating how they were thinking or feeling about park management or restoration such as when they discussed climate change altering the trajectory of park ecosystems, or ramping up the prescribed fire program. However, the majority of information I received from participants about the ecological effects of climate change, invasive species, historical fidelity, novel ecosystems, other restoration categories, and criticisms of how the park handled the aftermath of the fire was obtained through asking my questions and not while discussing the photos themselves. Issues around governance, resources, and collaboration across jurisdictions were also not discussed

when looking at the photos. Perhaps additional photos could have been used to focus the discussion on restoration more, as the landscape view is quite broad. For example, I could have supplemented the landscape photographs with photos of specific restoration sites, invasive species, or more focussed views of the burned area from the ground at different points, for example, from the lower elevation portions that were regenerating quickly to the high elevation parts that were still barren. Additionally, presenting digital versions where the images flowed into one another could have been another tactic to enhance engagement.

I would not argue that the photos were unimportant in my interviews, as they offered an opportunity for participants to describe the Kenow fire's behaviour, impacts, and regeneration in rich details. In more than half my interviews the photos decreased the awkwardness and interrogative feeling that face-to-face interviews can have, and helped create a bridge between me and the participants, especially those that I was meeting for the first time. Though I did not include this participant in the code co-occurrence analysis it is worthwhile to note the ability of the photos to elicit rich dialogue with someone who works in cultural resources whose job is naturally attuned and focussed on the past. As I mentioned in the previous section, I excluded this person from the code co-occurrence analysis to get a better sense of what people who worked in resource conservation were saying, but the photos were excellent at providing a visual foundation for this person to tell stories about the history of the landscape and the peoples who inhabited it, and in some cases, challenged their perceptions about what the landscape should have looked like based on what they had read.

Importantly, taking the third-view photos myself allowed me to deepen my own connection to the landscape. von Hellerman (2020) states the act of repeat photography “forces the researcher to spend a lot of time walking through forests and fields, along paths and beyond

them, encountering different people in the process, and so creating new social situations and relations” (p.364). The knowledge and experience I gained through hiking to the stations to take the photos helped me to be able to share my own insights about landscape changes I saw, and to connect with the participants. This lived experience was more enriching than simply reading about the park prior to doing my interviews.

There are some limitations to this research. Firstly, it is a fairly small sample size of 14 and only includes Parks Canada staff. It would be interesting for future research to investigate the elicitation potential of these photos with other groups such as ranchers, tourists, or town citizens, as many photo-elicitation studies have interviewed these groups with great success (i.e. Berbés-Blázquez, 2012; Garrard et al., 2012; Sherren et al., 2012; Groshong et al., 2018). Secondly, it was my first time conducting interviews, and while I thought I did a good job in helping the participants feel at ease and making it feel like a conversation, there were moments where I could have asked more follow up questions or asked participants about specific areas in the landscape I was curious about. I kept my questions broad as a way to reduce potential bias in the information produced, but perhaps more specific links between my questions and the photos could have enhanced the interview process.

What follows in chapter 6 is a synthesis of my entire research project, including recommendations for future research using photo-elicitation in a parks context.

Chapter 6: Synthesis

This thesis began by describing the Kenow fire and the very high severity impacts it had across nearly half of Waterton Lakes National Park in 2017. The landscape has been reset in ecological succession, and multiple trajectories are possible for the park's ecosystems under pressures from global change. The Kenow fire was chosen as a case study to explore park management approaches in times of rapid change for this reason, and because it was a significant event in the lives of people working and living in the park. On top of this, more severe disturbances could continue to happen under climate change in Waterton and elsewhere, and there are benefits in learning about one park's experience in depth. For my first research question I wanted to know how people managing the park's ecosystems were experiencing the effects of the Kenow fire, and in what ways the severity and extent of the fire may have shaped their attitudes toward intervening in park ecosystems, specifically in the form of ecological restoration.

Resource conservation staff, along with participants from cultural resources, communications, and a retired park warden, offered insights into their personal experiences with the severity of the Kenow fire and how it impacted their jobs. Participants also offered insights into their approach to park management, specifically ecological restoration, in the wake of the fire. They offered their thoughts on the role of history in ecological restoration, climate change adaptation, and various conservation adaptation approaches such as novel ecosystems and assisted migration. The insights offered in this thesis shed light on some challenges and opportunities facing national parks in the wake of extreme disturbance events.

Scientific repeat photography from the Mountain Legacy Project formed the visual backdrop for this research. The photographs portrayed the Waterton landscape and the visible changes therein over the past century, in 1914, 2004, and 2019, after the Kenow fire. The photographs were used in the interviews as talking points through the method of photo-elicitation as a way for participants to discuss landscape change, their personal experiences with the fire, and various topics around park management. For my second research question I wanted to gain insight into the strengths and challenges that third-view repeat photographs present in the photo-elicitation method in parks research.

In this chapter I will summarize the findings pertaining to my two research questions which were discussed in Chapters 4 and 5. I will offer recommendations for future research on the part of Parks Canada and the broader research community. I will finish with a discussion of the implications of the research laid out here.

In what ways does the staff's experience, combined with the severity and extent of the Kenow wildfire, shape their attitudes toward intervening in park ecosystems in the form of ecological restoration? How do they consider the role of history and climate change in decision making?

The Kenow fire was significant, and participants had wide-ranging personal experiences with the event. Some participants lived close to the park and their homes, and those of their neighbours, were threatened, which was highly anxiety-provoking. Some participants witnessed such drastic change to ecosystems they loved that they felt true grief and a sense of being disoriented in places they once knew well. Other participants were not as deeply impacted, but

were excited about the opportunity to learn about how the landscape would respond to such an event. All were gratified to witness wildflower regrowth in the prairie ecosystem in particular.

A surprising finding emerging from my interviews was that of the challenges the park faced in the aftermath of the Kenow fire. Several participants commented that Parks Canada's efficiency in handling the reverberations of emergency events was not as strong as how they manage the emergencies themselves. Stress was a common theme expressed by many participants due to increased workloads and being displaced from their offices and homes in the immediate aftermath of the event. Funding constraints slowed hiring processes which led to a backlog of work and not enough capacity to tackle it all. This, along with a lack of clear objectives, led to some challenges in rebuilding infrastructure efficiently. Additionally, I was told it was a certain staff's responsibility to undertake Critical Incident Debriefs to check in about the emotional toll the fire had on people working in the park, and they did not have training in this area; this amplified personal stressors.

While there were challenges faced by the park immediately after the fire, there were some opportunities. The Kenow fire destroyed some infrastructure in the park, but conservation gains were made in reconstruction. In Crandell campground, for example, a wildlife corridor was created to minimize the amount of human-wildlife conflict that was typical for the campground which was at the confluence of two valleys. There has also been an increase in the amount of research being done in the park in collaboration with other universities and organizations.

Through my research I came to understand that while the experience of the fire was emotional for a wide variety of reasons, the personal experiences of participants, and the experience of the park organization as a whole, didn't necessarily influence attitudes toward intervening in park ecosystems in the form of ecological restoration. There are as of yet no plans

for restoration in the form of planting species in the burned areas that have been slow to regenerate, though this could change as new data emerges in the coming years. It appears that the attitudes held before the fire occurred are the same attitudes guiding decisions now, which is to let nature take its course, observe change, and only intervene if there are threats to public safety or tangible threats to ecological integrity (e.g., invasive species; or threats to whitebark and limber pine including blister rust and bark beetle). The severity and extent of the fire encouraged the park to embrace the idea of renewal, signifying an opening up to a changed landscape more suited to the current and future climate. This, along with advice from experts, means that waiting for the first 5 years after the fire to see what successional changes happen before making any decisions about guiding the ecological trajectory has become the overarching approach for managing the park after the Kenow fire.

Dealing with invasive species is the primary active management activity WLNP is focused on, and they follow an early detection, rapid response protocol. The Play, Clean, Go program, created in Minnesota and adopted for broad use across Canada by the Canadian Council on Invasive Species (CCIS) in 2016 (CCIS, 2020), was introduced after the Kenow fire to educate the public about how they act as vectors for bringing invasive species into the park. This led to the coordination of volunteers at trailheads to check in about invasive species before tourists set out on recreational hikes, and the installation of boot cleaning equipment. I was told that while the park doesn't necessarily grasp how the invasive species program will change in the coming years, they may need to consider more aggressive tactics: "weed pulling on a landscape the size of a national park, however small... we just can't manage and keep up" (P13).

The Kenow fire created more opportunity for prescribed burning to occur. Now that much of the canopy is removed in vast portions of the park, there is less risk of a fire getting out

of control and threatening infrastructure and the public safety. Restoring a historic fire cycle and maintaining heterogeneity across the landscape is an important climate change adaptation strategy (Millar et al., 2007; Hessburg et al., 2015; 2019). While the fire caused serious setbacks in the whitebark and limber pine restoration program through killing potential resistant trees and newly planted seedlings, it also increased site availability to focus restoration efforts because planting in recently burned sites is highly favourable for restoration.

Even though the park is open to and expecting change, there are several important roles that historical knowledge currently play in decision making in WLNP: history as governor, history as reference, history as legacy, history as redress. Historical knowledge as reference in restoration is used in setting prescribed burning targets and in whitebark and limber pine planting site selection. History as redressing past harms can be seen in restoring negative human impacts from gravel pit creation in construction efforts. Additionally, the prescribed burning program can be seen as a way to redress the impacts that fire suppression policies had on the landscape over the past century. The ecological legacies of history such as living trees, dead trees, seeds, rhizomes, and nutrients, will play a role in constraining change and encouraging resilience to the Kenow fire (Higgs et al., 2014), though changing disturbance regimes, novel disturbances, or interacting disturbances, could threaten this capacity (Johnstone et al., 2016).

History as governor suggests historical knowledge plays a tempering role in decision making. This was strongly evident in the wake of the Kenow fire. Let nature take its course, which is a more passive management approach, was how the park framed their management approach to the Kenow fire. They want to wait and see what happens in the next several years as these ecosystems adapt. This approach shows humility because it embodies restraint, resisting meddling and over asserting control over these ecosystems. It also shows respect for nature in

trusting that nature knows what to do. This restraint is informed by the past and how people managing ecosystems, such as through fire suppression, often did so with significant unintended consequences. At the same time, active management needs to be taken to manage the park and protect at-risk species. Decisions for active management are also approached with restraint and humility, relying on the best knowledge available to inform decisions. An emerging question I have is whether there is too much restraint and humility, as more intervention, or different types of intervention, may be called for in the coming decades as pressures from global change increase.

My research highlighted the fact that while WLNP is adapting to climate change passively through allowing the park to regenerate as it will under this current climate, there is not a lot of clarity on how to tackle climate change in ecological restoration specifically. While informal brainstorming is said to occur frequently, and WLNP participates in the national workshops on climate change adaptation, I did not receive clear answers on adaptation plans that were currently in place. It appears they are in the beginning stages of formulating their plans on how to adapt ecological restoration practices and to adapt their ecological integrity monitoring measures. In cultural resources and environmental assessment there was also uncertainty but discussions we said to be underway. Challenges mentioned by participants in adapting to climate change included the short management plan windows of ten years, the fact that climate change works on longer time scales than a person's career, and lack of knowledge, or uncertainty. This aligns with challenges highlighted by Lemieux et al. (2011a) and Barr et al. (2020) who surveyed managers in parks and protected areas on how climate change is being addressed in Canada. They found that a park's priorities are typically focused on immediate threats like invasive species, infrastructure management, visitor and recreation services, and raising revenues, rather

than climate change which was perceived to be more a future concern (Barr et al., 2020). Nonetheless, WLNP is already fulfilling many recommendations on how to adapt to climate change already through practicing adaptive management and taking an ecosystem-based approach; having strong trans-boundary partnerships; and practicing ecological restoration to “maintain and restore ecological integrity” (p.92). Additionally, WLNP and all other parks fulfill an important role in climate change monitoring, as “benchmarks for change” to measure change in non-park areas against (Lemieux et al. 2011. p.93).

In my interviews I asked only one question about novel ecosystems but ended up discussing this concept more than I anticipated. My findings highlighted serious concerns that participants had about this concept, which could be problematic for Parks Canada in facing adaptation to global change pressures. The novel ecosystem concept was generally perceived with caution and in a negative light, though some participants were more open to paying attention to it. The primary concern was a fear of giving up on invasive species and losing sight of the purpose for representative ecosystems in Parks Canada’s portfolio. These impressions could stem from a misunderstanding of what the concept means, and specifically what it would mean for their park or Parks Canada as a whole. The concerns also reflect more persistent and troublesome concerns that affront people’s values, as Standish et al. (2013) explained.

At the time of interviewing -- two and a half years after the fire -- there were no significant restoration plans for the burned areas except removing invasive species, prescribed burning, and planting whitebark and limber pine. There were no plans to experiment and plant southern adapted species or novel species mixes that might be more adapted to climate change, as some scholars have suggested. The severity and extent of the fire did not seem to shape the

way they are approaching restoration. However, this could change in the coming years depending on vegetation regeneration.

What are the broader themes, and specific issues, that long-term repeat photography can elicit around ecological restoration and park management? How do participants engage with the photos? And in what ways is photo elicitation an effective method in park management research?

Third-view photographs of mountain landscapes have seldom been used for photo-elicitation. The exception are two previous studies by MLP researchers Falk (2011) and Walsh (2015), and a study by Garrard et al. (2012), who examined community members perceptions of ecosystem services in Nepal. As I discussed in chapter 5, the themes and issues talked about most frequently by participants in relations to the photos were renewal, fire behaviour, and ecological impacts of the Kenow fire. Additional themes and issues that were discussed more often by participants include vegetation encroachment, other disturbances such as bark beetle or floods, personal narratives, other snapshots, and ecological effects of climate change. While participants tended to discuss prescribed burning and whitebark and limber pine restoration while looking at the photos, the photos did not elicit much information about other ecological restoration issues in WLNP, such as invasive species, aquatic restoration, novel ecosystems, or historical fidelity, relative to some of the other themes.

It is a risk using researcher-chosen photos because as much as one can try to select photos that are of interest to the research project and captivating in their own ways, it does not necessarily mean people will have much to say about them. Eight of fourteen participants

engaged well with the photos, and six did not without being prompted by my questions. This could have been due to the photos being too obvious and not offering new perspectives, a lack of connection of participants with the landscape, or that they were landscape scale rather than fine scale. To better get an understanding of my participants perceptions on ecological restoration, it may have been better to show them specific restoration sites or species of concern or interest. None of the photos showed the office buildings which was a place where a lot of the personal experiences participants had with the fire happened in. Even if the photos did show it, they may not have been able to portray the complex lived experiences people had there.

Some participants may have been thrown off by this new interview technique that they had not experienced before. They may have been less comfortable with speaking about the photos at will and instead expecting questions to be asked of them that were specific to a research agenda. Focus groups could have also offered a different way to engage those people who didn't have high engagement with the photos themselves, the method used by Falk (2011). More engagement could have been facilitated by a digital presentation of the photos where participants could zoom in, pan, and switch back and forth between past and present images. In a similar way, a digital presentation where the photos are aligned, placed on top of one another, and slowly fade from one to the next, could allow the viewer to watch changes occur slowly which could be a highly compelling and immersive way to compare the photos (Klett, 2011).

The format and style of the photos is important to consider. As Tinkler (2014) argued, a small photo in a locket will be received differently than that same photo blown up and presented in a book. In a similar way, a photo presented framed on a wall compared with a photo that one can hold in their hands and touch create two different engagement experiences, and some participants might need touch to appreciate the photo (Tinkler, 2014). There lacks concrete

guidance in the literature in how to optimize these choices of presentation for a study, Pauwels (2015; 2020) argues. Pauwels (2015; 2020) calls for researchers to be more reflexive about their methodological considerations and for a review of researcher's experiences with different format styles (framed/unframed), technologies (film, digital, paintings, Skype), interview types (focus group, interview), among other considerations. It could be beneficial for researchers to test out different formats before embarking in their research to gauge their effectiveness.

Even though I hesitate to argue the photos had significant benefits in uncovering the information I discussed in Chapter 4, they were quite powerful in drawing out personal stories and memories from participants. For those participants who did engage, they really did engage and have much to say; they seemed also to enjoy the process. The photos did create an interesting "third-party" in the interview that helped create a connection between me and the participant in many cases. Additionally, my own experience taking the photos, walking the landscape, and witnessing the landscape changes firsthand, helped me to connect with my participants.

Recommendations for Future Research in Photo-Elicitation

There is an opportunity for the broader parks research community to explore the use of these third-view photographs in photo-elicitation further with surrounding communities and tourists. There is a call for more social science research in parks and protected areas (Bennett et al., 2017). Photo-elicitation can engage community members, landowners, tourists, and First Nations about matters that pertain to the park and their livelihoods in and around it. The photographs can be used as a tool to break down power dynamics by providing a third-party in

an interview, meeting, or focus group setting. I was told that there is often a tense relationship between communities living in parks and the park itself, therefore photo-elicitation could lend itself well to engagement and involvement with park communities in management planning, for example. Photo-elicitation has a benefit of giving participants ownership of the research and knowledge produced. This is especially true when the participants take the photos themselves (Beilin, 2005; Berbés-Blázquez, 2012; Castledon et al., 2008; Tinkler, 2014), though the MLP photos could also serve as a third party. Baxter et al. (2015) installed a series of repeat photos in a town hall to engage community members and gather their perceptions about changes they've seen in their Main Street over time. A similar, participatory installation of the photographs where community members can gather and discuss the photos could provide a rich experience for them and also generate useful qualitative data for the park.

The photos can be beautiful in their own right, and powerful in showing significant changes over a century or more. One of the participants that I spoke with who was part of the Cultural Resources unit had much to say about the storied history of the landscape. The photographs themselves portray a compelling story about landscape change that could be used in communications and in contributing to Parks Canada's goal of Connecting with Canadians. Including them in educational displays in certain areas of the park, with quotes from park staff and local people about what changes they are noticing, would be an excellent way to inform the public about the dynamism of the park's ecosystems and the indigenous peoples' and settler history of the place.

Recommendations for Parks Canada

Based on what I learned in my research, there are several recommendations for future research, and strategic approaches that might offer benefits to Parks Canada. First, English (2018) highlighted a lack of research on how park staff in Parks Victoria, Australia, experience and manage stress and trauma in their workplaces. English (2018) highlighted that even when there was immediate support for staff after natural disaster events, there was limited long-term support. Like the work of English (2018) in assessing how Parks Victoria's critical incident system is structured and how it serves staff, research by Parks Canada into how their staff cope with critical incidents such as wildfires would be a useful avenue to explore. They could audit the processes in place after the fire to see what was effective in supporting staff immediately, and whether they feel supported over the long term. In a time where more people are feeling climate and ecological grief (Cunsolo & Ellis, 2019), it's important to give voice to this aspect of the human experience because parks are not only compelling and inspiring places, they are workplaces, too (English, 2018).

The findings in this research also highlighted that post-emergency processes in the organization are not as streamlined as they could be. One comment by a participant about how managing for the recovery of situations like Kenow fire, floods, or snowstorms, was not "in the business plan" of Parks Canada stood out to me. Given that fire seasons are lengthening, and climate change is causing fires to become more severe and large, strengthening the post-emergency business plan of Parks Canada is an important area to focus efforts on to help support staff with the resources they need in the immediate aftermath of events such as the Kenow fire. The Burned Area Emergency Response (BAER) Program in the United States was put forth by one participant as a model program to efficiently tackle all the work that needs to get done after a

fire occurs. The BAER brings in a team of staff from outside the park to conduct immediate assessments on damage, and the staff in the park can focus on other important work. Parks Canada could heed this advice and look into what could be learned from programs like BAER to strengthen their post-emergency response program.

It is a difficult decision to determine when and how to intervene in ecosystems because of their complexity and ever-present scientific uncertainty. While there are currently no active ecological restoration plans beyond invasive species management, prescribed burning, and restoring whitebark and limber pine, if WLNP staff did want to pursue active restoration, a decision support tool to guide restoration planning was created by Stevens-Rumann et al. (2019). The support tool takes into consideration trends in post-fire seedling establishment under climate change and accounts for forest and climate type, distance to seed source, aspect and elevation, slope, and competing vegetation. Stevens-Rumann et al. (2019) suggest planting in sites that are more than 200 metres from living seed trees, on less than 45-degree northeast slopes which are generally cooler and wetter and will have greater probability of success. Halofsky et al. (2018) suggest taking advantage of the opportunity to experiment by planting native or novel species mixes in areas characterized by stand-replacing fires regimes that have been recently burned, as well as leaving some areas as controls. While this is an adaptive management approach, there is an unconventional quality to it in suggesting novel species mixes or southern adapted species which may not be in alignment with the values and goals of Waterton Lakes.

To strengthen the foundation of climate change adaptation in WLNP, having a designated scientist focusing on climate change issues in parks could help. Nelson et al. (2020), in their National Climate Change Adaptation Strategy for parks and protected areas, argued that a designated climate change champion to keep strategic planning, monitoring, and evaluation on

task is critical for effective adaptation. This could be a hired position, or a member of the current team that takes on this additional role. A designated aquatic biologist position was created in Waterton Lakes in 2017, whereas previously the wildlife ecologist did both terrestrial and aquatic ecology. There is no designated climate change scientist in the park itself. There is, however, a climate change scientist in the national office. A potential future direction for Parks Canada could be to create positions for climate change scientists in each park, or one for each park regions such as the Rocky Mountain parks.

A participant said that the Kenow fire was the impetus to adapt to climate change which signals a reactive response to climate change adaptation rather than proactive one. This goes against the accepted fact that adaptation needs to be proactive to be cost effective and efficient in the long-term (Lemieux et al. 2011; Barr et al., 2020). This is not the fault of Waterton Lakes or is the responsibility theirs alone. Surveys have shown there is a lack of coordinated national effort, including across jurisdictions and organizations, in parks and protected areas climate change adaptation (Lemieux et al. 2011; Barr et al., 2020). As previously mentioned, Nelson et al. (2020) created a framework to guide adaptation in Parks Canada, but whether there is any coordinated long-term support by the Parks Canada Agency beyond that is unclear. The Parks Canada Agency should redouble their efforts to enhance coordination, planning, and knowledge sharing across jurisdictions to formulate a proactive response to the threats of climate change (Barr et al., 2020).

Given that the last policies and guidelines for ecological restoration in Parks Canada were published in 2008, it may be pertinent for the organization to advance an updated version of the document that addresses important topics in protected areas management that are being discussed more and more such as conservation triage, assisted migration, and novel ecosystems. My

findings suggest there is significant debate throughout the organization on these topics. Distilling some guiding principles for parks to consider as they face increasing impacts from global change should be a priority. Clearly these are issues WLNP is already facing: hybrid fish, introduced turkeys, lack of bison, threats to whitebark and limber pine as keystone species, and invasive plants becoming naturalized. It can be assumed this is happening in other parks as well, perhaps even more quickly in places like the Arctic. There needs to be more engaged discussion to come up with policies and guidelines to handle ecological novelty including how to study it, how to talk about it, and how to define it. As Lemieux (2016) suggested, Parks Canada needs to determine the degree of change that “falls within acceptable limits” (p.434) of ecological integrity.

In putting forth recommendations on how to study and manage ecological novelty, the approach of Heger et al. (2019) is notable. Heger et al. (2019) offered a conceptual framework for ecological novelty as an umbrella concept that encompasses novelty arising at the organism and ecosystem level, rather than using the term novel ecosystems. This approach may help avoid apparently polarizing debates on novel ecosystems and offer a practical way to study emerging ecological novelty. Ecological integrity monitoring measures in Parks Canada could be adapted to fit in this research and monitoring framework. Dialogues that involve ecosystem scientists from all parks should be facilitated to allow them to voice their comments about ecological novelty, assisted migration, and conservation triage. These dialogues, and recommendations from contemporary literature in ecological restoration and conservation, can feed into an updated principles and guidelines for ecological restoration in Parks Canada.

Finally, I am curious as to whether the let-nature-take-its-course framing is problematic as it still clearly inscribes the wilderness ethic. One definition of naturalness by Aplet & Cole

(2010) is not controlled by humans for any goal, self-willed, and autonomous. While this approach tries to show respect for nature's autonomy (Landres, 2010), the wilderness framing still separates people from the other-than-human world of which they have been apart since time immemorial (Aplet & Cole, 2010; MacLaren, 1999). Human agency is intertwined with ecology, and is seldom some separate processes fully taking their course. Active interventions are still happening. The ecological trajectory is being guided through prescribed burning, removal of invasive species, planting whitebark and limber pine. There is never a passive approach because passivity is still a decision. One participant said it, "we have to make decisions to manage this place" (P10). Because of the problematic wilderness framing, I suggest a different framing: We, and the decisions we make, are *a part of* nature taking its course, and we make these decisions based on the best information available at the time, our relations with the land and each other, and with history as our guide.

Limitations of this Research

There is value in place-based research, but there are also limitations in the scope of research implications. Furthermore, due to funding and time constraints I did not include the voices of First Nations, community members, ranchers, or members of other organizations such as the Nature Conservancy of Canada who operate lands outside the park. Future research could try to understand how these other groups experienced the Kenow fire and their attitudes toward Parks Canada's management approach. The interview format could have influenced the results in that participants may have biased or tailored their own responses based on my presence as the researcher, or that participants may not have remembered or articulated events accurately (Creswell, 2013; Yin, 2014). This was addressed to the best of my ability through searching for

disconfirming, or contradictory, evidence to ensure validity. This research took place only 2 years after the fire and there is still much uncertainty about what will happen on the ground regarding vegetation regrowth in the coming years and decades will likely impact future management decisions. Nobody knows what the landscape is going to do and what trajectory the ecological communities will take. In this liminal phase, only so much can be inferred as everyone waits to see what happens.

Contributions of this Research

My research has shed light on some key issues relating to parks and protected areas adaptation that I hope may be beneficial for the Parks Canada Agency to reflect and act upon now and into the future. It has highlighted that the post-emergency response can be strengthened which is important in a time where more intense and frequent natural disasters may become commonplace. It has highlighted the many ways in which historical knowledge is still operative and important and governs many decisions made. It has shown that climate change adaptation is stalled which will seriously hinder the resiliency of all parks in the future as the climate continues to warm. It has elucidated some nuance as regards hesitations felt by park staff relating to unconventional management approaches such as novel ecosystems, signaling a need for more focused conversations throughout the organization. I have described the personal experiences of people working in the park and the challenges they have faced to shed light on the human aspects of conservation. Recognizing that parks are people's workplaces, and the changes that happen in them impact the people working in them on deep levels. I have also documented and explored some of the very significant landscape changes that occurred as a result of the Kenow fire

through repeat photography. The repeat photograph collection can continue to be built upon throughout time and used for ongoing monitoring of landscape change. The information held within the photos is a rich repository that will continue to serve park management and inspire the public.

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Appendices

Appendix A: Initial Invitation Letter

Dear XXXXX,

I invite you to participate in an interview discussing the implications of the Kenow wildfire on park management and ecological restoration activities in Waterton Lakes National Park in March 2020. My name is Cassandra Buunk and I am a masters student in the School of Environmental Studies at the University of Victoria. My supervisor is Dr. Eric Higgs who specializes in ecological restoration, landscape change, and philosophy around changing nature, and has been running the Mountain Legacy Project for the past 20 years.

For my thesis research I am interested in exploring the human side of park management and ecological restoration and how the people managing our National Parks are grappling with major disturbance events in the context of rapid ecological and climate change. Ecological restoration has a strong social element in that people are deeply connected to the landscapes that they live and work in, and their perceptions about the landscape and what they value as individuals plays into decision making. I am interested in understanding the impacts that the Kenow wildfire is having on the ways that park staff are thinking about and approaching ecological restoration and the role of history in ecological restoration, how people are thinking about the concept of ecological integrity, and any potential challenges and opportunities presented by the Kenow wildfire in managing the park in the years to come.

I obtained your email from the Parks Canada directory as you were recommended to me. You are being asked to participate in this study because you have been working in Waterton Lakes in some capacity involving ecological monitoring and/or planning and implementing ecological restoration activities. Further, you have been working in the park for many years and have an understanding of how the park was before the fire and can thus better comment on how social and ecological context may have changed after the fire. By participating in this study you may need to make arrangements with your supervisor for the interview if it occurs during your scheduled work time.

Long term landscape change is being documented through scientific repeat photography as part of the Mountain Legacy Project, the largest systematic repeat photography project in the world. The repeat photographs will be used in the interviews as talking points to discuss change and the impacts of the fire.

I hope that you will be interested in participating in my research project. If you have any further questions, please feel free to contact me. I look forward to hearing from you.

Kind regards,

Cassandra Buunk

Masters Student
School of Environmental Studies
University of Victoria

Appendix B: Participant Consent Form



**University
of Victoria**

Participant Consent Form

Making Sense of Change in Waterton Lakes National Park

You are invited to participate in a study entitled **Making Sense of Change in Waterton Lakes National Park** that is being conducted by Cassandra Buunk.

Cassandra Buunk is a masters student in the School of Environmental Studies at the University of Victoria and you may contact her if you have further questions by emailing _____ or phoning at ###-###-####

As a master's student, I am required to conduct research as part of the requirements for my masters degree. It is being conducted under the supervision of Dr. Eric Higgs. You may contact my supervisor at _____ if you have any questions.

This research is being funded by the Social Science and Humanities Research Council (SSHRC).

Purpose and Objectives

In 2017 the Kenow wildfire burned 38% of the area within Waterton Lakes National Park at high to very high severity. The purpose of this research project is to gain an understanding of how people working intimately with the landscape of Waterton Lakes National Park are experiencing the effects of the 2017 Kenow wildfire, how people are thinking about ecological integrity and ecological restoration, what the role of history is in ecological restoration in WLNP, and what challenges and opportunities the Kenow wildfire may be creating for ecological restoration and conservation. This research falls within the Mountain Legacy Project, the largest systematic collection of repeat photographs– a project aimed to understand long term landscape change in Canada's Rocky Mountains.

Importance of this Research

Research of this type is important because there is a need to understand both the natural and the social dimensions of conservation including ecological restoration. Social sciences can be a powerful way to explore things like the ways of thinking that influence conservation practices, and how and why people make certain management decisions over others. The practice of ecological restoration has a strong social component in that people are deeply connected to the landscapes that they live and work in, and their perceptions about the landscape and what they

value as individuals plays into decision making. The Kenow wildfire had profound ecological effects on the landscape in Waterton Lakes. This research will make a contribution to the wider body of knowledge around managing protected areas in the context of rapid ecological and climate change and highlight how the people managing our National Parks are grappling with major disturbance events. Furthermore, by using historical images as a talking point, the role of history in ecological restoration, which has been shifting over the past decade, can be explored.

Participants Selection

You are being asked to participate in this study because you have been working in Waterton Lakes in some capacity involving ecological monitoring and/or planning and implementing ecological restoration activities. Further, you have been working in the park for many years and have an understanding of how the park was before the fire and can thus better comment on how social and ecological context may have changed after the fire.

What is involved

If you consent to voluntarily participate in this research, your participation will include taking part in a semi structured interview using photo-elicitation. The interview will take place at the Parks Canada office in WLNP. It will be flexible with no set time limit, but ideally between 1 to 2 hours. When we have our conversation, I will show you select images from the Mountain Legacy Project photo collection. WLNP was re-photographed once in 2004 so we now have “third-views” of most areas of the park, including a historic view, a pre-fire and post-fire view. I will present the images to you so that you may reflect and comment on the changes you see based on your knowledge and experience working in the park. You may draw on the images to annotate areas of interest, I will take photos of your annotations to assist me when I transcribe the interviews. The interview will be recorded using an audio recorder. I will then listen to the audio recordings and make notes and transcribe the information therein. If you have further reflections that you’d like to share with me after the interview has concluded you may send them to me in email or request a phone call.

Inconvenience

By participating in this study you may be inconvenienced in the form of time, as you will have to take time out of your work schedule to be interviewed. The inconvenience to you can be accommodated, as you can decide your level of involvement and the ideal time that works for you, e.g. if you only have 1 hour to dedicate to the interview.

Risks

There are no known or anticipated risks to you by participating in this research. If anything is disclosed in the interview that you feel would put your job at risk, you may request that it is not included in the research findings and that will be honoured.

Benefits

You will have an opportunity to share your experience, knowledge and stories about the landscape, history, and management of Waterton Lakes National Park, and the impacts of the Kenow wildfire and how it influences conservation and ecological restoration activities. Your participation can contribute to a greater understanding of the human experience of working in

and managing our National Parks, and protected areas management in general, in the context of large ecological disturbance events and climate change.

Voluntary Participation

Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation by notifying the researcher by email or phone. If you do withdraw from the study, you may also request that your data be withdrawn from the study.

On-going Consent

To make sure that you continue to consent to participate in this research, I will notify you of any changes to the research project that may affect you and you may reconsider your consent accordingly. If the data may be used in the future for another purpose, beyond the scope of this research project, I will notify you to obtain consent. You may also state that you do not consent to data being used in future research at the bottom of this form.

Anonymity

In terms of protecting your anonymity, you will have the choice of remaining anonymous or being acknowledged by name when I write my results. The population of staff working in WLNP is small, so there is a chance some of the information discussed in my research would be recognizable by others. If you prefer to remain anonymous, I will do my very best to make you as anonymous as possible in the writing and dissemination of my results.

Confidentiality

As mentioned previously, due to the small population of employees at WLNP, the focused nature of my research, and the fact that you were recommended to participate, I cannot guarantee confidentiality. The confidentiality of the data itself will be protected by being stored on an encrypted computer in a secure location.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in the following ways. The research being conducted here will be used in my master's thesis which will be shared on the University of Victoria theses database. It is anticipated that the results will be disseminated in a research publication and/or at a conference, and potentially a blog post for the Mountain Legacy Project website. The data will be archived by myself and protected in digital research files, housed on the protected University of Victoria server.

Storage and Archival of Data

Data from this study will be stored indefinitely on an encrypted hard drive at the University of Victoria.

Contacts

Individuals that may be contacted regarding this study include the researcher, Cassandra Buunk and her supervisor, Dr. Eric Higgs

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

| | | |
|----------------------------|------------------|-------------|
| _____ | _____ | _____ |
| <i>Name of Participant</i> | <i>Signature</i> | <i>Date</i> |

Please initial these statements if you consent:

I consent to be identified by name / credited in the results of the study: _____
(Participant Initial)

I consent to have my responses attributed to me by name in the results: _____
(Participant Initial)

Future Use of Data

I consent to the use of my data in future research: _____ (Participant to provide initials)

I **do not** consent to the use of my data in future research: _____ (Participant to provide initials)

I consent to be contacted in the event my data is requested for future research: _____
(Participant to provide initials)

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix C: Ethics Approval



University
of Victoria

Office of Research Services | Human Research Ethics Board
Michael Williams Building Rm B202 PO Box 1700 STN CSC Victoria BC V8W 2Y2 Canada
T 250-472-4545 | F 250-721-8960 | uvic.ca/research | ethics@uvic.ca

Certificate of Approval

| | | | |
|------------------------|---|-------------------------------|----------------|
| PRINCIPAL INVESTIGATOR | Eric Higgs (Supervisor) | ETHICS PROTOCOL NUMBER | 19-0410 |
| PRINCIPAL APPLICANT | Cassandra Buunk Master's student | Expedited review - delegated | |
| UVIC DEPARTMENT | Environmental Studies | ORIGINAL APPROVAL DATE | 05-Nov-2019 |
| | | APPROVED ON | 05-Nov-2019 |
| | | APPROVAL EXPIRY DATE | 04-Nov-2020 |

PROJECT TITLE **Making sense of change in Waterton Lakes National Park**

RESEARCH TEAM MEMBERS **None**

DECLARED PROJECT FUNDING
Social Sciences and Humanities Research Council, UVic

DOCUMENTS INCLUDED IN THIS APPROVAL
AppendixA_Initial_Invitation_Letter.pdf - 04-Nov-2019
AppendixE_Consent_Form_WLNP_2019.pdf - 09-Oct-2019
AppendixB_Interview_Questions.pdf - 09-Oct-2019
AppendixD_Example_photos.pdf - 30-Sep-2019
AppendixC_References.pdf - 30-Sep-2019

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

Renewals
Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

Dr. Rachael Scarth
Associate VP Research Operations

Certificate Issued On: 05-Nov-2019

Appendix D: List of Photos

| Surveyor | Year | Station Name | Photo Number |
|-----------------|-------------|--|--|
| Wheeler | 1915 | Mt. Festubert | 4-2 (16) |
| Wheeler | 2004 | Mt Festubert | B0012P0189 |
| Wheeler | 2019 | Mt Festubert | DSCF3912 |
| Bridgland | 1914 | Stn. 87 Blakiston Divide (Panorama) | (right) BRI1914_B14-580; (left) BRI1914_B14-575 |
| Bridgland | 2004 | Stn. 87 Blakiston Divide (Panorama) | (right) B0014P0041; (left) B0014P0042 |
| Bridgland | 2019 | Stn. 87 Blakiston Divide (Panorama) | (right) DSC_6760; (left) DSC_6756 |
| Bridgland | 1914 | Stn. 84 Blakiston Shoulder | 549 |
| Bridgland | 2004 | Stn. 84 Blakiston Shoulder | B0013P0021 |
| Bridgland | 2019 | Stn. 84 Blakiston Shoulder | DSCF3890 |
| Bridgland | 1914 | Stn. 98 Blakiston Mouth | e004414487 |
| Bridgland | 2004 | Stn. 98 Blakiston Mouth | B0012P0135 |
| Bridgland | 2019 | Stn. 98 Blakiston Mouth | DSC_6737 |
| Bridgland | 1914 | Stn. 111 Cameron Bend | BRI1914_B14-740 |
| Bridgland | 2004 | Stn. 111 Cameron Bend | B0013P0048 |
| Bridgland | 2019 | Stn. 111 Cameron Bend | DSC_6814 |
| Bridgland | 1914 | Stn. 79 Lakeview Ridge | e004414399 |
| Bridgland | 2004 | Stn. 79 Lakeview Ridge | B010P00023 |
| Bridgland | 2019 | Stn. 79 Lakeview Ridge | DSCF3938 |
| Bridgland | 1914 | Stn. 85 Anderson | e004414417 |
| Bridgland | 2004 | Stn. 85 Anderson | B012P0005 |
| Bridgland | 2019 | Stn. 85 Anderson | DSCF3847 |

Appendix E: Interview Questions

Script:

My name is Cassandra and I'm a graduate student at the University of Victoria in the School of Environmental Studies. Thank you so much for taking time out of your busy work schedule to participate in my research study, I really appreciate it. My research project is part of the Mountain Legacy Project which is one of the largest systematic repeat photography projects in the world. A couple years ago this park was transformed by the Kenow wildfire, and that's largely why the Mountain Legacy Project is involved again, to document landscape change through repeat photography as part of the vegetation monitoring program. I had a really wonderful time here last summer hiking up to some incredible viewpoints to retake these photographs and it was a truly special experience. Through my time here and also in my studies I have become quite interested in understanding how the people working here have been experiencing the fire and see it as a fascinating opportunity to not only act as a living lab to better understand post-fire ecology, but also to learn more about parks and protected areas management, especially in the context of large ecological disturbances and climate change.

This will be a photo elicitation interview so I will be showing you photos from 1914, 2004, and 2019. I acknowledge that the Kenow wildfire was a traumatic experience for some people, and that it may be difficult to see some of the photos. If at any time you feel uncomfortable seeing the images, please tell me and we can continue without looking at them if you would like to continue. In the consent form I state that participation is voluntary and can be withdrawn by the participant at any time, and that includes in the interview itself. There would be no pressure to proceed if you are uncomfortable and do not want to proceed. If you don't want to answer particular questions you can say no.

I'll get people to sign the consent form and I will ask if they consent to being interviewed.

Also, I encourage you to answer questions in the area of your expertise and not feel like you need to answer anything that isn't in your area.

Background of participant

1. Can you introduce yourself and tell me about how you came to work in Waterton Lakes National Park, what your job title is, and what you do in your work here?
 - How many years have you been doing your job?
 - Have you been involved in ecological restoration in the park?
 - What parts of the park do you usually work in, and have you explored a lot of the park?
 - Have you worked at any other parks?

The Kenow Wildfire

2. Can you tell me about your experience with the Kenow wildfire in 2017? What was it like leading up to the fire and how did you feel throughout the time it was happening?

- How was fire talked about among staff before the Kenow wildfire and what has changed about the way people talk about fire now, after the Kenow wildfire?
- What was it like coming back to the park for the first time after the fire?

Landscape Change

3. We will cycle through some images sets now. Take your time to look at them, and when you feel ready, I'd like to hear about what comes to mind for you when you think about the landscape changes that have occurred over the past century in WLNP.
 - What are the most significant changes you are seeing in the photos, and in your time working here, and why do you think these changes are happening?
 - What have you been witnessing on the landscape after the fire and is anything surprising? Is there anything that looks the same?
 - How was the Kenow wildfire different than other disturbances that WLNP experiences?
 - What do you value in this landscape, in these photos?

Ecological Integrity and Ecological Restoration

4. When thinking about Parks Canada's primary management objective of ecological integrity, what comes to mind regarding the impacts of the Kenow wildfire?
 - The definition of ecological integrity includes the phrasing "acceptable rates of change" and species "characteristic of a natural region", do these terms need to be modified in light of climate change and invasive species?
5. In my reading about Parks Canada it is clear that ecological integrity has been stated to be the first priority in managing our National Parks. What does prioritizing ecological integrity as the "first priority" mean to you in decision making?
6. Are you involved in ecological integrity monitoring and reporting, and are you aware of the indicators used to measure integrity in Waterton? If so, can you explain on how you decide which ones to use and how you use them? Also, based on your experience with the fire are there any new or additional indicators that you think WLNP needs to assess ecological integrity into the future, and any indicators you don't think are appropriate anymore?
7. There have been several studies in the past few years, including a meta-analysis, looking at tree regeneration rates across the Rocky Mountain range that have found reduced tree regeneration and forest resilience after wildfires. This has to do with post-fire climate and moisture factors, distance to seed source, and other factors like slope and aspect. Can you comment on what you are seeing on the landscape in Waterton after the fire and what the implications would be if there was reduced forest regeneration in Waterton?

- In what ways are you seeing the effects of climate change and how do you think it is impacting/may impact the park in the future?
 - What trajectory do you think this landscape will take in the coming years/decades?
8. Given how complex ecosystems are, how do you approach uncertainty in managing the park's ecosystems in general? I understand that Parks Canada tries to take an adaptive management approach, can you comment on what that looks like here in Waterton?
 9. Under what circumstances would you intervene and actively restore a burned area of the park and are these circumstances occurring?
 - In what ways has the conversation around invasive species changed after the Kenow wildfire?
 10. How is climate change considered when planning restoration projects, and has this changed after the Kenow wildfire?
 - How do you think climate change may impact ecological restoration policy in Parks Canada in the coming decades?
 11. Is ecological restoration after the Kenow wildfire an efficient use of resources compared to other priorities?
 12. Have you encountered any challenges in managing the burned areas of the park and if so, what are they? Are there any opportunities that the Kenow wildfire has created for ecological restoration?
 13. I'm part of a research group that is interested in the idea of ecological novelty or novel ecosystems - ecosystems that have no historical precedent due to factors like invasive species, nitrogen deposition, and altered disturbance regimes, and can't be practically restored back to a historical state. Have you ever heard of this terminology and way of conceptualizing change, and has this terminology been used in the park context? If not, then how do you think about the concept of restoring "back to" an ecosystem state in the past, and is that, or in what ways might that be, changing for you?
 14. How would you evaluate the role of historical information, and historical photos in particular, in ecological restoration?
 15. Do you feel that the values and perspectives guiding parks management in Parks Canada have changed over the span of your involvement? How?
 - Is there a challenge in balancing recreation and conservation management priorities in the park and has this changed after the fire?

- Has cooperation with other management agencies working in the area increased after the Kenow wildfire? In what ways?
16. What has the response from the public been like after the fire? In what ways has the park's involvement and participation with the public surrounding park management issues changed after the Kenow wildfire?

Emotion and the Human Experience

17. Have you noticed yourself having an emotional response around how the landscape in Waterton has changed over time, especially after the Kenow wildfire – and would you be open to sharing?
- What brings up these feelings in you?
 - Is there a difference in how you feel when you walk through the park now compared to when you walked through before the fire?
 - How has the fire impacted your job?
18. What have you learned from your experience with the Kenow wildfire?

What is missing or not represented in these photographs?

Appendix F: Code List

| Code | Groundedness |
|--------------------------------------|---------------------|
| * Human influence in wild places | 10 |
| *Interesting Quote | 73 |
| *Metaphor | 43 |
| CLIMATE CHANGE | 0 |
| Climate Change: adaptation | 34 |
| Climate Change: communication | 2 |
| Climate Change: ecological effects | 45 |
| COLLABORATION | 0 |
| Collaboration: indigenous | 12 |
| Collaboration: other jurisdictions | 28 |
| Collaboration: researchers | 23 |
| Collaboration: volunteers | 6 |
| Collaboration: with landowners | 2 |
| Collaboration: within Waterton | 6 |
| CULTURAL | 0 |
| Cultural: Archaeology | 33 |
| Cultural: Indigenous history | 24 |
| Cultural: Indigenous land management | 19 |
| Cultural: Settler history | 17 |
| ECOLOGY | 0 |
| Ecology: encroachment | 29 |
| Ecology: fire history | 20 |
| Ecology: other disturbance | 31 |
| Ecology: wildlife | 48 |
| EMOTION KENOW | 1 |
| Emotion Kenow: disoriented | 7 |
| Emotion Kenow: excitement | 16 |
| Emotion Kenow: frustration | 7 |
| Emotion Kenow: happiness | 18 |
| Emotion Kenow: relief | 10 |
| Emotion Kenow: sadness | 18 |
| Emotion Kenow: shock | 8 |
| Emotion Kenow: stress | 12 |
| Emotion Kenow: supported | 7 |
| Emotion Kenow: surprise | 23 |
| Emotion Kenow: worry/anxiety | 23 |
| Emotion not Kenow related | 15 |
| ER: *ECOLOGICAL RESTORATION | 6 |

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| ER: aquatic | 22 |
| ER: baselines | 15 |
| ER: disturbed site/gravel pits | 10 |
| ER: fescue | 27 |
| ER: historical fidelity | 23 |
| ER: invasive species | 81 |
| ER: novel ecosystems | 34 |
| ER: prescribed burn | 51 |
| ER: reintroduction of species | 5 |
| ER: restoration success | 2 |
| ER: seeding/planting | 25 |
| ER: whitebark/limber pine | 31 |
| GOVERNANCE | 0 |
| Governance: federal agency | 17 |
| Governance: legislation | 15 |
| Governance: management plan | 12 |
| Governance: policy | 8 |
| Governance: politics | 5 |
| HUMAN EXPERIENCE | 0 |
| Human: Acceptance or rejection | 11 |
| Human: Hope/Optimism | 9 |
| Human: Learning | 22 |
| Human: Personal values/approach | 21 |
| Human: Sense of place | 9 |
| Human: Shifting baseline | 4 |
| Human: Work being busy | 23 |
| KENOW FIRE | 0 |
| Kenow: criticism | 13 |
| Kenow: ecological impacts | 55 |
| Kenow: fire behavior | 47 |
| Kenow: informative/context | 64 |
| Kenow: no/little regrowth | 11 |
| Kenow: renewal/regeneration | 59 |
| Kenow: speculation about renewal | 31 |
| Kenow: visual description | 21 |
| MANAGEMENT Approach | 0 |
| Management approach: active | 21 |
| Management approach: balance dual priorities | 29 |
| Management approach: fire suppression | 20 |
| Management approach: misc | 7 |
| Management approach: passive/leave it be | 22 |
| Management approach: science based | 14 |

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| Management approach: value judgements | 9 |
| PARK MANAGEMENT | 0 |
| Park Management: access | 14 |
| Park management: challenge | 38 |
| Park Management: ecological integrity | 49 |
| Park Management: fire management | 19 |
| Park Management: infrastructure | 48 |
| Park management: monitoring | 41 |
| Park management: opportunity | 21 |
| Park management: past management | 21 |
| Park Management: species-at-risk | 22 |
| PHOTO ELICITATION | 0 |
| Photo Elicitation: 1914 | 125 |
| Photo Elicitation: 2004 | 101 |
| Photo Elicitation: 2019 | 161 |
| Photo elicitation: experience - orienting themselves | 26 |
| Photo elicitation: experience: awkward/unsure | 11 |
| Photo elicitation: experience: enjoyment | 14 |
| Photo elicitation: experience: noticing something | 4 |
| Photo elicitation: experience: relating to photos | 5 |
| Photo Elicitation: photo appearance | 27 |
| Photo Elicitation: lack of change | 27 |
| Photo Elicitation: missing | 16 |
| Photo Elicitation: other snapshots | 30 |
| Photo Elicitation: personal narrative | 29 |
| Photo Elicitation: value of photos | 17 |
| PUBLIC | 0 |
| Public: human wildlife conflict | 5 |
| Public: perception/opinion | 28 |
| Public: public outreach | 26 |
| Public: public safety | 28 |
| Public: townsite | 31 |
| Public: visitor use/visitation | 31 |
| RESOURCES | 0 |
| Resources: funding: external | 23 |
| Resources: funding: internal | 10 |
| Resources: limited | 6 |
| Resources: non-monetary | 11 |