Adaptive Capacity Creation in the Stó:lō Research and Resource Management Centre (Stó:lō Nation, BC) and the Fort Apache Heritage Foundation (White Mountain Apache Tribe, AZ)

by

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Bachelor in Social Sciences, Universidade Federal do Rio Grande do Sul, 2016

Project Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Resource Management

in the

School of Resource and Environmental Management
Faculty of Environment

Project No. 730

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SIMON FRASER UNIVERSITY

Summer 2019

Approval

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Degree: **Master of Resource Management (Planning)**

Report No.:   **730**

Title: **Adaptive Capacity Creation in the Stó:lō Research and Resource Management Centre (Stó:lō Nation, BC) and the Fort Apache Heritage Foundation (White Mountain Apache Tribe, AZ)**

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Date Defended/Approved: July 12th, 2019 _____

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Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

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Abstract

Indigenous peoples are disproportionately threatened by a changing climate. Research indicates that U.S. Tribes and Canadian Aboriginal Peoples are experiencing detrimental climate change effects. In this context, Indigenous organizations deserve special consideration as community-based pathfinders for collective welfare. I engaged with two Indigenous organizations that share cultural heritage stewardship missions—the Stó:lō Research and Resource Management Centre (Stó:lō Nation, BC) and the Fort Apache Heritage Foundation (White Mountain Apache Tribe, AZ)—to investigate perceptions of climate effects and develop recommendations for organizational support of community adaptive capacity. Research methods included engagement with organizational collaborators, semi-structured interviews with organizational representatives and community members, and organizational documents review. Results indicate that community members are experiencing increase in extreme weather events, changes in water quantity and quality, reductions in long-term water and food security, and reduced access to traditional resources and traditional practices. Results identify diverse opportunities to enable adaptation, most of which are case study-specific. Educational services and information dissemination, cultural perpetuation services, and cooperation facilitation comprise organizational services associated with adaptive capacity enhancement in both case studies. I conclude that Indigenous organizations hold significant potential to support communities in adapting to a changing climate. I identify recommendations to boost and actualize this potential.

Keywords: Indigenous adaptation to climate change; community adaptive capacity; Indigenous organizations; Indigenous perspectives of climate change; Stó:lō Research and Resource Management Centre; Fort Apache Heritage Foundation

Dedication

       I dedicate this thesis to the wonderful research participants that made it possible. It is challenging to express the degree to which certain interviews influenced me as I listened to them, transcribed them, and read them again and again. I have been gifted with deeper understanding and wisdom than I could ever have attained through study of written content. I especially thank Stó:lō and Apache participants for sharing their wisdom with me, and hope that this thesis can start to repay them in goodness, although written content falls short.

      "There is a goodness within everybody, and if you share that, you share those good feelings with something, it comes back. . . . So, to be in a good mind, in a good heart, in a good spirit, it is what we say. To be all good, all together. Lets'emó:t"— Ernie Victor

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List of Acronyms

AZ	Arizona
BC	British Columbia
CAQDAS	Computer Assisted Qualitative Data Analysis Software
CIER	Centre for Indigenous Environmental Resources
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
DFO	Oceans and Fisheries Canada
DOI	U.S. Department of the Interior
FAHF	Fort Apache Heritage Foundation
FAO	Food and Agriculture Organization of the United Nations
FBC	Fraser Basin Council
FSC	Food, Social, and Ceremonial
INAC	Indigenous and Northern Affairs Canada
IPCC	Intergovernmental Panel on Climate Change
LFFA	Lower Fraser Fisheries Alliance
LMFMS	Lower Mainland Flood Management Strategy
MARRC	Ministry of Aboriginal Relations and Reconciliation
NHL	National Historic Landmark
ORE	Office of Research Ethics
PDO	Pacific Decadal Oscillation
PICS	Pacific Institute for Climate Solutions
PRRO	People of the River Referrals Office
SEA	Strategic Engagement Agreement
SRRMC	Stó:lō Research and Resource Management Centre
SSA	Stó:lō Service Agency
STSA	S'ólh Téméxw Stewardship Alliance
SXTA	Stó:lō Xwexwilmexw Treaty Association
TPPR	Tribal Plan and Project Review Panel
WMAT	White Mountain Apache Tribe

Chapter 1.

Background

1.1. Adaptation to Climate Change

Global climate change is pervasive and unequivocal. Each of the last three decades has been successively warmer than any decade since 1850. Change is further reflected in diminishing glaciers and polar icecaps, rising sea levels, and increasing frequencies of extreme weather events and ecosystem responses, including wildfires, floods, and droughts (IPCC 2014).

Adaptation and mitigation comprise the two frameworks developed to respond to anthropogenic climate change. Mitigation refers to efforts to reduce the sources or enhance the sinks of greenhouse gases. Adaptation to climate change has been defined in various ways in the literature. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)* defines adaptation as the process of adjustment to actual or expected climate and its effects (IPCC 2014). Adaptation actions seek to moderate climate change effects, to avoid harm, or to exploit beneficial opportunities stemming from such effects (IPCC 2014).

Research on adaptation to climate change has been gaining importance as it becomes clear that the amount of greenhouse gases emitted to date will lead to climatic changes regardless of future emissions reduction, in addition to climatic change that has already occurred (Füssel and Klein 2006). Research on adaptation proves itself valuable as adaptation (i) is tailored to specific regional or local scopes and their needs, (ii) is potentially immediate in its benefits, and (iii) can foster co-benefits to the scope it is tailored to, especially when paired with adaptive capacity enhancement (Füssel and Klein 2006).

The concept of adaptation can be classified as being either autonomous (e.g., changes in ecological communities following climatic change) or purposefully planned (e.g., construction of new infrastructure taking climate projections into consideration).

Adaptation is further classified as anticipatory or reactive based on the timing of the adaptation in place, although Füssel (2007) warns that this distinction can be unclear in practice, as adaptation to climate change is a continuous process. It is consistent throughout the literature that planned adaptation to climate change holds the potential to reduce adverse effects on a given system through "the use of information about present and future climate change to review the suitability of current and planned practices, policies, and infrastructure." (Füssel 2007, 268)

Adaptations also vary in space and time scales and by the phenomena of interest (biological, economic, social, etc.) (Smit and Wandel 2006). Here I apply the concept of adaptation in its relation to human systems, bearing in mind that social systems are in constant interaction with and depend upon natural systems. It is important to note that human adaptation to climate change is a broad field that is far from comprising a delimited set of activities (Füssel 2007). What constitutes an adaptation action and how these can be classified is debatable. For instance, Smit et al. (1999) classify possible measures of adaptation into structural, legal, institutional, regulatory, financial, and technological adaptation. Füssel (2007) refers to Smit et al. (1999) but also mentions educational and behavioral measures, including research as a facilitator of adaptation actions. Biagini et al. (2014) develop a typology consisting of ten types of overarching adaptation actions based on their analysis of ninety-two projects financed under the United Nations Framework Convention on Climate Change (UNFCCC). The authors find that the most recurrent measures are adaptation enabling ones, such as capacity building, policy reform, planning, and management.

The concepts of adaptation, adaptive capacity, vulnerability, exposure, and sensitivity are closely interrelated. The vulnerability of a system refers to a function of the exposure and the sensitivity of the system to climate impacts, as well as its capacity to cope with said conditions (Smit and Wandel 2006). The exposure and the sensitivity of a system reflect the likelihood and the extent to which the given system may be exposed to climate impacts, and the degree to which these impacts positively or negatively affect the system, respectively (Gallopín 2006; Smit and Wandel 2006).

In other words, the higher the exposure and the sensitivity of a system, the more vulnerable it is, while the higher the adaptive capacity of a system, the less vulnerable it is. This framework can be thus summarized: "Adaptations are manifestations of adaptive

capacity, and they represent ways of reducing vulnerability." (Smit and Wandel 2006, 286) Even though each of these concepts is neatly distinguished in the literature, the determinants and processes driving them are frequently interdependent. These elements are also dynamic and vary according to time and system of analysis (Smit and Wandel 2006).

Adaptive capacity refers to a given unit's ability to adjust to climate change, including both anticipatory and responsive adaptation actions (Smit and Pilifosova 2001). Some authors differentiate between the ability to develop shorter-term responses that do not fundamentally alter the system's adaptive capacity—referring to these as coping ability (Smit and Wandel 2006), coping mechanisms (Berkes and Jolly 2002), or capacity of response (Gallopín 2006)—and longer-term, sustainable adaptations, as a reflection of adaptive capacity (Smit and Wandel 2006) or adaptive strategies (Berkes and Jolly 2002).

Smit and Wandel (2006) also draw attention to the fact that adaptive capacity is context-specific and varies according to the unit of analysis, as well as within a given unit (i.e., different households within a community may hold different levels of adaptive capacity). The authors thus explain the *nested quality* of this concept: "The scales of adaptive capacity are not independent or separate: the capacity of a household to cope with climate risks depends to some degree on the enabling environment of the community, and the adaptive capacity of the community is reflective of the resources and processes of the region." (Smit and Wandel 2006, 287)

The concepts of adaptation opportunities and constraints are closely related to that of adaptive capacity. The *IPCC Fifth Assessment Report (AR5)* defines adaptation opportunities as enabling factors that increase the likelihood of adaptation actions being undertaken (Klein et al. 2014). These include sustainable economic development, climate education, stakeholder entitlement to resources, availability of appropriate tools and policies to support adaptation, and innovation and learning (Klein et al. 2014). Adaptation constraints, or elements that act as barriers for adaptation actions to be undertaken, are manifold. Klein et al (2014) classify these as economic, financial, human resource, social/cultural, and governance and institutional constraints. Adger et al. (2007) also bring forward the topic of *perceived* barriers to adaptation, meaning that

groups who think of themselves as vulnerable might act as such, thus implementing a self-fulfilling prophecy.

1.2. Indigenous Peoples and Climate Change

Human systems' differences in vulnerability and adaptive capacity arise from non-climatic factors, such as socioeconomic inequalities and uneven development processes. Such differences shape differential risks stemming from climate change (Noble et al. 2014). Indigenous peoples[1] comprise some of the social groups that are disproportionately threatened by a changing climate (Bennett et al. 2014). In Indigenous contexts, vulnerability and adaptive capacity to climate change cannot be separated from the history of Western colonization (Redsteer et al. 2013).

One of the reasons for this differential risk lies in the ancestral connections that tie Indigenous peoples to their traditional territories and resources. As climate change affects Indigenous peoples' local environments, it holds potential to equally affect Indigenous culture and language (Turner and Spalding 2013). Bennett et al. (2014; see also CIER 2008) identify additional reasons for this differential risk, including:

- Socioeconomic vulnerabilities that Indigenous peoples and settlements are currently faced with;

- Lack of sufficient financial, scientific, and technological resources for adaptation planning;

- Remote locations of communities and limited transportation options;

- Limited or zero relocation options;

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[1] The United Nations defines the term Indigenous based on self-identification with pre-colonial and pre-settler societies, and employs it as a universal term for these peoples in the *United Nations Declaration on the Rights of Indigenous Peoples*. Aboriginal peoples of Canada are defined on Section 35 (2) of the *Constitution Act, 1982* to include the Indian, Inuit, and Métis peoples of Canada. First Nations is the preferred term for so-called Indian communities. I employ the term Native American here to specifically refer to Indigenous populations of the United States.

- Historical establishment of Indigenous settlements (e.g., U.S. Indian reservations) in regions characterized by poorer land quality and extreme environments.

Bennett et al. (2014, 298) further state, "The consequences of observed and projected climate change have and will undermine indigenous ways of life that have persisted for thousands of years." Such a statement provides supporting evidence for the differential risk that climate change poses to Indigenous peoples; however, it might prove itself untrue. Despite innumerable efforts dedicated to their debilitation and assimilation Indigenous peoples continue to insist upon and exercise inherent rights to self-determine their beliefs, cultural traditions, and lifestyles (UN General Assembly 2007).

The distinction between increased Indigenous vulnerability to climate change and insufficient adaptive capacity is essential to understanding and empowering Indigenous responses. Identified vulnerabilities stemming from colonial processes signify that Indigenous peoples are more exposed and more sensitive to climate change effects; however, this should not be taken to mean that Indigenous adaptive capacity is necessarily lower compared to non-Indigenous groups. On the contrary, studies indicate that Indigenous ways of knowing can enhance adaptive capacity within as well as beyond Indigenous contexts (Berkes 2012; Turner and Spalding 2013; Williams and Hardison 2013).

Regarding North American Indigenous peoples and climatic impacts, various U.S. Tribes and Canadian Aboriginal Peoples are already experiencing harmful effects of climate change (Bennett et al. 2014; CIER 2008). First Nations will likely be among the most heavily affected social groups by climate change in Canada. Severe weather, changes to precipitation patterns, milder winters and hotter summers, impacts to winter road travel, and increases in pest problems are among current impacts (CIER 2008).

There are similarities in current and projected climate change effects to First Nations in Canada and to Native American Tribes in the U.S. The Centre for Indigenous Environmental Resources (CIER) published a report on climate change impacts and adaptation for First Nations south of 60 degrees latitude. This report identifies five priority climate change impacts to First Nations: (i) changes in water quality and quantity,

(ii) increase in frequency and severity of extreme weather events, (iii) increase in frequency and severity of forest fires, (iv) changes in animal behaviour and loss of keystone species, and (v) changes in snow and ice due to warmer weather (CIER 2008). First Nation resource-dependent and subsistence economies are also projected to be particularly affected by global climate change (CIER 2006b).

According to the *Third National Climate Assessment*, key climate impacts to U.S. Native American Tribes include increase in wildfires, diminished access to traditional foods, impacts on crops, changing water availability, permafrost thaw and its socioeconomic effects and, in some cases, need for relocation (Bennett et al. 2014). Bennett et al. (2014, 299) express particular concern with climate change effects to Native American Tribes due to a number of "adverse social indicators," such as pervasive poverty on reservations (28.4% poverty rate), lack of electricity (over 14% of reservation homes), and lack of running water (20% of reservation homes).

More recently, in the *Fourth National Climate Assessment*, Jantarasami et al. (2018) focus on how climate impacts to tribal lands, water, traditional foods, and resources are threatening Native American subsistence, economies, and health. Health impacts are not only physical, but mental and, according to an Indigenous perspective, inextricably linked to relations with the land (Jantarasami et al. 2018).

1.3. Research Framework

Adaptation to climate change is a recent field, and scholarship is rapidly expanding. The literature has so far relied on theoretical approaches more than on empirical data, whereas the analysis of development and implementation of adaptation actions is still nascent (Biagini et al. 2014). The literature on climate adaptation has been largely focused on discussion of methodologies and procedures for impact and vulnerability assessments, when compared to the analysis of adaptation actions (Smit and Wandel 2006).

One study that analyzes the implementation of adaptation actions is Biagini et al.'s (2014) analysis and typology of adaptation projects financed under the UNFCCC and managed by the Global Environment Facility. One of the findings is that "while the science is important as a guide, ultimately what works and is likely to be successfully

implemented to a large degree depends on the communities themselves and their awareness and willingness to act." (Biagini et al. 2014, 105). In spite of such findings, most decision-making guidance regarding adaptation to climate change has followed a rational-linear process that flows directly from assessed impacts and risks to the recommendation of planning and management responses, with less attention to sociocultural perceptions and community contexts (Jones et al. 2014). Such approaches have been criticized for not properly addressing the diverse sociocultural contexts and decision-making processes within which climate decisions are made (Smit and Wandel 2006; Dovers 2009). Being contingent on social values, objectives, and risk perceptions, adaptation planning and implementation can benefit from recognition of specific sociocultural factors operating in a given context (Jones et al. 2014). Given these considerations, the research design is aligned with a research stream that aims to investigate the ways in which a given system or community experiences changing climatic conditions and the processes of decision-making that guide adaptation actions and improve adaptive capacity (Smit and Wandel 2006). Moreover, the research project seeks to recognize that Indigenous knowledge systems and practices constitute important resources for adapting to climate change, and that integrating such forms of knowledge with existing practices has the potential to increase adaptation effectiveness (Turner and Clifton 2009).

This research project is built upon engagement with two Indigenous organizations. Local organizations comprise fundamental social units within which decisions regarding adaptation take place (Berkhout, Hertin, and Gann 2006). As such, understanding processes of adaptation to climate change at the micro-level of organizations holds potential for guiding macro-level interventions. Indigenous non-governmental organizations deserve special consideration as community-based and often inspirational pathfinders for collective welfare (Hardy and Peachey 2015). Implicit in the research design is a theory that Indigenous organizations have key roles to play in supporting Indigenous communities, and that the participant organizations are positioned to facilitate climate change adaptation on behalf of their community clients and stakeholders.

I would also like to emphasize that research design, primary objectives, and participant recruitment were developed in collaboration with the participant organizations. Results presented and discussed in this research project stem from a

partial (organization-centered) view of researched topics and may not fully represent community—Stó:lō First Nations and the White Mountain Apache Tribe—perspectives and realities.

1.4. Participant Organizations

This research project is built upon engagement with two North American Indigenous organizations that have parlayed cultural heritage stewardship missions into broad engagements with self-determination, self-governance, and self-representation—the Stó:lō Research and Resource Management Centre (Stó:lō Nation, BC) and the Fort Apache Heritage Foundation (White Mountain Apache Tribe, AZ). I proceed to describe the organizations and the communities they serve below.

Stó:lō Research and Resource Management Centre (SRRMC)

The Stó:lō comprise a supra-tribal collective of Halq'eméylem-speaking peoples whose traditional territory consists of approximately 1.2 million hectares in the Lower Fraser River watershed in BC. For the Stó:lō, this is *S'ólh Téméxw* ("Our World" or "Our Land") (Schaepe 2007, 246). Stó:lō is a Halq'eméylem word meaning "river" or "the Fraser River." The Stó:lō have inhabited the Lower Fraser River watershed since time immemorial, their connection to the Fraser River being expressed in their self-identification as people of the "river of rivers." (Carlson 2001a, 24) Stó:lō tribes have been divided and Stó:lō land, restricted to Indian reservations that represent a small fragment of traditional territory, since the Fraser River Gold Rush in the 1850s (Carlson 2001b).

Stó:lō is employed here as a collective identity of First Nations that were originally socially organized into different tribes inhabiting the Lower Fraser River (Schaepe 2009). Schaepe (2009, 34) warns that Stó:lō identity is one within a spectrum of possible identities and affiliations existing among Stó:lō First Nations, which range from family and Indian Band/First Nation, to tribal and supra-tribal affiliations. The Stó:lō are associated with a cultural group anthropologically defined as the Coast Salish, which would comprise a broader cultural affiliation.

The Stó:lō Research and Resource Management Centre (SRRMC or Centre), based in Chilliwack, BC, is a branch of Stó:lō Nation—the political amalgamation of eleven Stó:lō First Nations, which also functions as a service delivery agency through the Stó:lō Service Agency (SSA). Seven Stó:lō First Nations are represented by another organization, the Stó:lō Tribal Council (Stó:lō Tribal Council, n.d.), while other Stó:lō First Nations are unaffiliated to either organization and referred to as "independent." The Stó:lō Nation has been focusing on heritage resource policy development and management planning, asserting Stó:lō identity through the development of the *Stó:lō Heritage Policy Manual* (Stó:lō Nation 2003a), the *Stó:lō Heritage Resource Management Plan* (Stó:lō Nation 2003b), and the *S'ólh Téméxw Use Plan Policy* (SRRMC 2014).

The SRRMC provides investigative and land and water stewardship support for the collective Stó:lō community—i.e., all Stó:lō First Nations. Its mandate is provide resources for Stó:lō communities to protect, preserve, and manage Stó:lō heritage according to the principle of Stó:lō stewardship "*S'ólh Téméxw te íkw'élò. Xólhmet te mekw' stám ít kwelát.*" ("This is our land. We have to look after everything that belongs to us.") In its origin, the SRRMC mainly focused on supporting assertion of Aboriginal rights and title (David Schaepe, pers. comm., July 24, 2017). The Centre has since evolved into providing a variety of professional and technical services to the collective Stó:lō community, specializing in areas such as support of Stó:lō self-governance, heritage research and resource management, fisheries management, geographic information systems, cultural education, among others (SRRMC, n.d.). The organization also functions as a centre for information and resources of value to the Stó:lō through its archives and library department, which houses varied records (e.g., oral Coast Salish histories), as well as through its material culture repository, which houses material culture (e.g., archaeological artifacts) (David Schaepe, pers. comm.).

The SRRMC provides support to other Stó:lō organizations, such as the Stó:lō Xwexwilmexw Treaty Association (SXTA), an organization that was formed to negotiate treaty for Stó:lō communities (SXTA, n.d.), and the S'ólh Téméxw Stewardship Alliance (STSA), a group of sixteen Stó:lō First Nations that focuses on land and resource stewardship and engages in consultation over development processes in *S'ólh Téméxw* (David Schaepe, pers. comm.). Provincial policies for First Nations consultation in BC are operationalized through the Crown's referral process (Morellato 2008). The SRRMC

houses the People of the River Referrals Office (PRRO), which supports the STSA through referral receiving, processing, and review (David Schaepe, pers. comm.). To engage in referral review, the PRRO employs the *S'ólh Téméxw Use Plan Policy*, a policy that depicts and recognizes Stó:lō connections to the land (SRRMC, n.d.), and of Stó:lō Connect, an online portal that connects Stó:lō communities as well as government and industry involved in referral management (Morrison 2013).

Fort Apache Heritage Foundation (FAHF)

Before the establishment of Indian reservations in the Southwest, the Western Apache or *Ndee* were divided into five subtribal groups—the White Mountain Apache, San Carlos Apache, Cibecue Apache, and the Southern and Northern Tonto Apache (Basso 1970, 1). In 1871, the White Mountain Indian Reservation was established in eastern Arizona, and Western Apaches, compelled to stay within the reservation (Welch and Brauchli 2010, 51). In 1897, a Congressional Act separated the reservation in two, establishing the Fort Apache Indian Reservation as the territory of the White Mountain Apache Tribe, since then adjacent but separated from the San Carlos Apache Tribe (Welch and Brauchli 2010, 51). By then, the majority of Western Apaches were settled on either reservation (Basso 1970).

Cline Griggs (pers. comm., May 24, 2017) discusses who White Mountain Apache Tribe members are as a people:

> We are people who were put on this part of the Earth, who have lived on the Earth as long as we can remember. . . . We have lived since time immemorial with what the Creator has given us. We have learned to farm, we have learned to hunt, to adapt, and we have learned how to live in two worlds now. The Anglo or the Western world that came upon us.

The Fort Apache Reservation covers over 1.67 million acres and is mostly comprised of White Mountain and Cibecue Apache descendants (Basso 1970, 18). From here on, I employ the terms "Apache" and "White Mountain Apache" to refer to White Mountain Apache Tribe members (independently of subtribal group ancestry). As Basso (1970, 17) notes, the area where the reservation was established comprised pre-reservation Apache territory, meaning that the Western Apache were never completely removed from their "original homeland." This is an enabling factor for continuing Western Apache identification with the land, which is inextricably linked to Western Apache

thought and culture (Welch 2009). The "inseparability of land and thought, of geography and memory," is reflected in the *Ndee* word *ni'*, which has multiple meanings: land, mind, country, and way of thinking (Welch 2009, 151). The White Mountain Apache were, however, increasingly restricted in their access to and sovereignty over their traditional land, as reservation area was subsequently reduced to allow for settler society land exploitation (Welch and Brauchli 2010, 51).

The current Fort Apache and Theodore Roosevelt School National Historic Landmark (NHL) was originally established in 1870 as a U.S. military facility with the consent of local Apache leaders (Welch 2019). In 1922, the Army abandoned the post, and the Fort Apache property was transferred to the Department of Interior (DOI) and employed as the site for an Indian school, the Theodore Roosevelt School—which taught children of varied Native American backgrounds while for many decades prohibiting Native languages to be spoken. The Fort Apache buildings and 400 acres of land were finally placed "in perpetual trust" for the Tribe in 1960 (Welch 2019, 77).

U.S. negligence and mismanagement of the Fort Apache property led the Tribe to file a lawsuit against the federal government for failure to meet fiduciary obligations and to recover damages to the property. In 2003, the Supreme Court found in favour of the Tribe, and in 2007 a settlement created a permanent fund to preserve the property (Welch 2019, 80). Fort Apache has thus been transformed from a site for the imposition of non-Apache values to an antidote to colonialism and symbol of the Tribe's legal victory (Welch and Brauchli 2010). In 2012, Fort Apache and Theodore Roosevelt School were designated as a National Historic Landmark (Welch 2019, 80).

The Fort Apache Heritage Foundation (FAHF or Foundation) non-profit was envisioned as a means for the advancement of Apache interests in Fort Apache, which entails the adoption of a sovereignty-driven approach to the organization's stewardship of the Fort Apache property. The 2007 settlement agreement established the Foundation as the property's manager. The Foundation has since invested major efforts to revitalize the property for community enjoyment, economic development, and tourism enhancement—between 2007 and 2014, twenty-two historic buildings were completed in their renovation and preservation work (Welch 2019, 81). The Foundation is now expanding its roles from heritage perpetuation into increasing efforts in education, community services, and economic development. The current Fort Apache Master Plan

(FAHF 2015) outlines diverse investments and partnerships required to transform the site from a reminder of colonial subjugation to a center of communal and entrepreneurial activity and a symbol of pride and hope for the White Mountain Apache Tribe.

1.5. Research Objectives

The participant organizations are aware that current and projected climate change effects comprise risks to the communities they serve. However, climate change adaptation had not been a specific focus of organizational work prior to this research project (FAHF case), or was nascent (SRRMC case). The organizations were interested in engaging in this research project to explore potential synergies between organizational work and community adaptive capacity enhancement. Given these considerations, the primary research objective is:

- Develop recommendations for the participant organizations to support the communities they serve in adapting to climate change.

As explored in section 1.1, climate change adaptation varies according to the chosen scope, phenomena of interest, and studied system context (Smit and Wandel 2006). A two-case study approach can be beneficial to elucidate common themes and key differences between case studies, and to ultimately draw conclusions regarding adaptation to climate change in North American Indigenous community contexts that may be useful to other Indigenous communities and organizations. Hence, the secondary research objective is:

- Qualitatively compare case study results and draw initial conclusions regarding North American Indigenous adaptation to climate change.

To support the primary and secondary research objectives, as ancillary research objectives, I aim to investigate:

i. Perceived climate change effects to communities,

ii. Actions being taken in communities to mitigate or adapt to effects,

iii. Community adaptation constraints and enablers,

iv.   Organizational support of climate adaptation.

Each of these ancillary objectives are explored in semi-structured interviews and developed into content analysis domains (see section 2.2 for data analysis). The first ancillary research objective is developed into the content analysis domains termed "observed climatic and environmental changes" and "reported cumulative effects on communities." Given that most climate change literature is not tailored to communities' scope and priorities, I decide to focus on community members' perceptions of climatic and environmental changes to their territories. In this way, I aim to provide the opportunity for community members to present their perspectives and illuminate novel themes that might not have been previously addressed in the literature, as well as to share local and traditional knowledge of changes in climate and their impacts to local environments and communities. I characterize reported effects as *cumulative* to acknowledge that this study does not provide scientific attribution of impacts to global climate change; hence, reported effects may share varied causes.

The second ancillary research objective is developed into the content analysis domain termed "identified adaptation actions." The third objective originates the domain "adaptation opportunities." This domain represents achieved understanding of community adaptive capacity, more specifically of actions that can promote adaptive capacity and overcome reported adaptation constraints. Finally, the fourth objective feeds into the domain "organizational roles." Organizational roles comprise participant perceptions of (i) organizational efforts that are currently supporting community adaptive capacity, and (ii) potential work supporting community adaptive capacity that is within organizational capacity.

Chapter 2.

Methods

Research methods included literature searches, collaborative engagement with key research participants/collaborators from the SRRMC and the FAHF, semi-structured interviews, organizational documents review, and qualitative content analysis using QSR International's NVivo 12 software. Research methods and processes are detailed in section 2.1, and data analysis methods are detailed in section 2.2.

Between September 2016 and May 2017, I reviewed literature on the following topics: (i) climate change impacts to North American Indigenous communities; (ii) adaptation to climate change, with an emphasis on North American Indigenous contexts; (iii) adaptation constraints and opportunities; and (iv) regional climate change effects relevant to the communities served by the SRRMC (Stó:lō First Nations) and the FAHF (White Mountain Apache Tribe).

According to McCracken (1988), the purpose of qualitative methodology is to describe and understand, rather than to predict and control. Qualitative methods are unique in that they are more intensive than extensive in their objectives, seek access to a given group's cultural categories and worldviews, and look for complex patterns of interrelationship between multiple categories (McCracken 1988). Given that the primary research objectives are specific to the participant organizations and associated communities, and that their pursuit requires a degree of access into the groups' perspectives, qualitative methods were deemed the most appropriate research design.

It is important to recognize that the methods employed in this study do not stem from Indigenous methodology. According to Kovach (2009), Indigenous methodologies share characteristics and can dialogue with qualitative research methodologies, but differ from these in fundamental ways. The most important shared attribute between these research traditions is the *relational* nature of research—which, in Western-based methodologies, is restricted to the relationships between researchers and participants.

Two fundamental differences between these traditions are rooted in their different language systems and knowledge systems. According to Kovach (2009), Indigenous

methodologies are guided by Indigenous languages and tribal epistemologies. Kovach (2009, 30) warns that Indigenous and Western knowledge should not be confused, for "knowledge is neither acultural nor apolitical."

In spite of its Western-based methodology, this study aims to conduct research that is ethically responsible and reciprocal with regard to the participant organizations and the communities they serve. Western research has traced a history of infringing Indigenous communities, which represents "an extension of the Indigenous-settler colonial project." (Kovach 2009, 142) According to Kovach (2009), decolonizing these relationships begins with the incorporation of Indigenous ethics review boards into research processes, as well as university ethics review that hold specific considerations regarding Indigenous community research. Additionally, numerous Indigenous research protocols have been developed. Aspects often emphasized by these protocols include the need for community participation in research, research participation consent, and research outcomes that accrue to community benefits (Kovach 2009).

This study involves collaboration on research processes and outcomes with the participant organizations. Key participants or collaborators comprise research participants involved in a collaborative process to guide the research design, support the development of recommendations for the organizations, review research outcomes, and possibly engage in co-publication.

Between September 2016 and May 2017, John Welch and I engaged with one collaborator from each participant organization to delineate the research design and discuss our proposed methods. John Welch and I developed a research proposal, a participant consent form, and a semi-structured interview guide, which were reviewed by the participant organizations, the White Mountain Apache Tribe's Tribal Plan and Project Review Panel (TPPR), and the Simon Fraser University Office of Research Ethics (ORE). Approvals from SRRMC's Research Registry, the TPPR, and the Research Ethics Review Board followed during the spring and summer of 2017. In May 2017, this research project was granted a Pacific Institute for Climate Solutions (PICS) 1-year Graduate Fellowship.

2.1. Data Collection

Data collection involved on-site information compilation and the conduction of twenty-seven semi-structured interviews at Fort Apache (AZ) and at the SRRMC (Chilliwack, BC) during the summer and fall of 2017. Research participants were comprised of SRRMC and FAHF board members and staff, as well as key community members and natural resources management staff that were identified as particularly able to provide relevant input given their traditional knowledge, knowledge of climatic change and/or environmental issues in the communities, or knowledge of the participant organizations and associated communities.

Recruitment stemmed from engagement with collaborators. These provided much needed support in introducing me to fellow organizational staff and board members, and in helping me identify which potential participants would be relevant to contact for the purposes of the research project. Following this initial contact, I proceeded to invite potential research participants to participate in the interviews, with the support of John Welch[2] and David Schaepe (collaborator). Certain research participants also directed us to additional potential participants that they deemed relevant to the research project. This recruitment method (contact of third parties) was necessary in this study, since it was not possible to aprioristically know who would hold information relevant to research objectives.

I strived to contact as many community members as possible (as opposed to non-Indigenous participants), and to maintain a balance between female and male perspectives. The final composition of research participants was based on these recruitment processes and principles, but also on the availability and willingness to participate of contacted parties.

Semi-structured interviews were conducted based on an interview guide (see Appendix A) which allowed for flexibility given participants' specific areas of knowledge or experience. This guide directed the interviews but did not preclude participants from contributing with novel themes, which could be further investigated if relevant to the

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[2]John Welch has worked in various capacities with the White Mountain Apache Tribe for over three decades. His long-standing relationship to the Tribe and to the Fort Apache Heritage Foundation was an enabling factor for my engagement with the Foundation.

project. The interview guide also allowed for small changes to reflect case study characteristics and terminology. Interviews were, on average, between 1 and 1.5 hours in length.

All participants received a consent form (see Appendix B), which outlined the voluntary nature of participation and provided participants with the choice to consent to participate or to decline participation, as well as to disclose their names or to remain confidential and be given a pseudonym in research outcomes. For the SRRMC case study, participants were given the choice to consent or not that their interview recordings and transcripts be deposited in the SRRMC Stó:lō Archives. Participants also had the opportunity to verbally consent to being recorded or not. I used an audio recording device to record all but one interview. Participants were not offered any incentives for their participation.

I conducted thirteen semi-structured interviews for the Stó:lō case study. Twelve interviews were located at the SRRMC, in Chilliwack. One interview was conducted in Kwantlen First Nation. Interviews were conducted between July and November of 2017. Seven participants were internal to the SRRMC (staff), while six participants were external. Eight participants were male and five were female. Two internal interviews were mostly focused on obtaining relevant information on the organization. While these provided valuable information for the development of organizational recommendations, they did not contribute as extensively to the analytic categories generated through the use of NVivo. Table 2.1 lists research participants and provides additional details.

Table 2-1.   Stó:lō case study research participants

Participant	Date	Relation to SRRMC	Affiliation
Naxaxalhts'i, Albert "Sonny" McHalsie	July 24, 2017	Staff	Shxw'owhamel First Nation
Carrielynn Victor	November 23, 2017	External	Cheam First Nation
Clarence "Kat" Pennier	September 21, 2017	External	Sq'éwlets First Nation
David Schaepe	July 24, 2017	Staff	Unaffiliated
Eddie Gardner	July 28, 2017	External	Skwah First Nation
Ernie Victor	July 26, 2017	Staff	Cheam First Nation
Joseph Anthony "Tony" Dandurand	September 22, 2017	External	Qw'ó:ntl'an First Nation
Maretta Beger	July 18, 2017	Staff	Skwah First Nation
Murray Ned	September 21, 2017	External	Sema:th First Nation
Patricia "Tia" Halstad	July 26, 2017	Staff	Unaffiliated
Shana Roberts	July 25, 2017	Staff	Unaffiliated
Stephen McGlenn	September 14, 2017	External	Sema:th First Nation staff
Taylor*	July 24, 2017	Confidential	Unaffiliated

*Pseudonym

I conducted fourteen semi-structured interviews in the White Mountain Apache Tribe. With the exception of one interview, which was conducted at the Sunrise Park Resort (Greer, AZ), all remaining interviews were conducted in public areas within Fort Apache. Most interviews were conducted at the FAHF headquarters building. All interviews were conducted during May and June of 2017. Eight participants were internal to the FAHF (board members and staff), while six were external. Four participants were male and ten were female. Similarly to the Stó:lō case study, two of the internal interviews were mostly focused on obtaining relevant information on the organization itself. Table 2.2 lists research participants and provides additional details.

Table 2-2.   Apache case study research participants

Participant	Date	Relation to FAHF	Affiliation
Alexis*	May 30th 2017	Confidential	Tribal member
Ali*	May 30th 2017	Confidential	Tribal member
Angel*	June 1st 2017	Confidential	Tribal member
Avery*	June 1st 2017	Confidential	Tribal member
Brenda Pusher-Begay	May 31, 2017	External	Tribal member
Cheryl Pailzote	May 24, 2017	External	Tribal member
Cline Griggs	May 24, 2017	External	Tribal member
Gwendena Lee-Gatewood	May 24, 2017	External	Tribal member (now Chairwoman)
Karl Hoerig	May 24, 2017	Staff	Tribal staff
Krista Beazley	July 2, 2017	Staff/CEO	Tribal member
Leeann Lacapa	May 31, 2017	Board of Directors	Tribal member
Rochelle Lacapa	May 26, 2017	Board of Directors	Tribal member
Rowena Cooya	May 31, 2017	Board of Directors	Tribal member
Shannon Tsosie	May 24, 2017	Board of Directors	Tribal member

*Pseudonym

2.2. Data Analysis

I transcribed twenty-six interviews. One of the participants asked me not to record the interview, but allowed me to record hand-written notes, on the basis of which I created a written summary of the interview. All interviews were submitted to content analysis using NVivo 12. Organizational documents were employed as complementary information for the development of recommendations and were not included in the content analysis.

Content analysis is a research method for the achievement of replicable and valid inferences from texts according to research purposes (Krippendorff 2004). Replicability entails that different researchers reach similar results when applying a common technique to the same data. Validity is achieved when research results withstand scrutiny and criticism, such as independently available evidence or competing interpretations (Krippendorff 2004).

This method is unique in its applicability to both quantitative and qualitative research designs, and in its possibility to be used in an inductive or a deductive approach (Bengtsson 2016; Elo and Kyngas 2008). The origin of quantitative content analysis lies in media research, while qualitative content analysis originated within the field of social research (Bengtsson 2016). However, neither quantitative nor qualitative

content analysis are particularly linked to any disciplinary field. This is a reflection of this method's flexibility and lack of specific rules other than suggested content analysis procedures (Bengtsson 2016; Hsieh and Shannon 2005). The choice between different modalities of content analysis depends on one's research goals. The use of content analysis here is inductive and qualitative.

In an inductive content analysis approach, the researcher analyzes the text in order to identify conclusions stemming from it. Conclusions or categories are thus drawn from the data and not predetermined (Elo and Kyngas 2008). Deductive reasoning, on the other hand, relies on predetermined categories or hypotheses which are to be tested through text analysis (Bengtsson 2016; Elo and Kyngas 2008). Another relevant distinction is that between manifest and latent analysis. In manifest analysis, coding stays close to the text and to its surface content. In latent analysis, coding aims for the underlying meaning of textual content (Bengtsson 2016; Cho and Lee 2014).

Qualitative content analysis is a research method that enables text data interpretation "through the systematic classification process of coding and identifying themes or patterns." (Hsieh and Shannon 2005, 1278) The data are presented as themes, and the focus is on exploring the meaning derived from the text that supports the categorization (Krippendorff 2004). In qualitative content analysis, it is possible to add information by conducting some form of quantification, such as the counting of generated categories and sub-categories. Such quantification procedures can be useful in suggesting the extent and significance of identified categories. Bengtsson (2016) warns, however, that quantified categories cannot be ranked in a qualitative study.

Bengtsson's (2016) literature review on qualitative content analysis concluded that there is a plurality of proposed procedures. In spite of this plurality, there is commonality in four essential procedure stages: decontextualization, recontextualization, categorization, and compilation. These stages prescribe how the analysis should proceed for maximized validity and replicability.

During decontextualization, the researcher should begin the analysis by reading the text as a whole to develop a holistic understanding of the data prior to starting the coding process. The coding then starts with the breaking down of text into meaning units. A meaning unit is defined as the smallest unit of text that contains meaning

pertaining to research questions (Bengtsson 2016). The researcher assigns a code to each meaning unit, creating a coding list.

After the text has been coded, the original text is read alongside the list of meaning units, which is termed recontextualisation (Bengtsson 2016). This stage of the process ensures that no relevant information is left uncategorized. Information that is irrelevant and not coded is then excluded from the data analysis process.

At this stage, the coded material is divided into domains, or "broad groups based on different attentions of the study." (Bengtsson 2016, 12) Bengtsson (2016) suggests that the material be divided based on the questions asked during data collection. Categorization, therefore, refers to the process of organizing codes into categories and sub-categories. Compilation then comprises the final process of translating the data analysis into a written description of achieved conclusions (Bengtsson 2016).

NVivo 12 is a Computer Assisted Qualitative Data Analysis Software (CAQDAS). The use of CAQDAS for qualitative data analysis has been lauded for its facilitation of accurate and transparent data analysis, and for its provision of an efficient means to analyze large volumes of qualitative data (Welsh 2002). However, there has also been criticism regarding the incentive that CAQDAS presents to analyze qualitative data in a quantitative approach (Welsh 2002). Welsh (2002) concludes that researchers should combine the best features of electronic and manual analysis methods to achieve optimal results.

I conducted the first two stages (decontextualization and recontextualization) manually by reading and qualitatively analyzing interview transcriptions. I then imported all coded material to NVivo 12, and initiated the process of categorization through the use of NVivo's node creation function. This function permits data visualization of the generated categories and sub-categories and creates documents displaying all coded text within each generated node or category. These processes were conducted separately for each case study. Finally, during the compilation stage, I wrote a results summary for each case study, which were further developed into chapters 3 and 4. In conclusion, NVivo 12 was useful as a categorization facilitator and as a data visualization tool. It did not prevent the need for manual analysis of transcriptions, however.

I categorized the data into domains according to the different themes that guided interview questions: observed climatic and environmental changes, reported cumulative effects on communities, identified adaptation actions, adaptation opportunities, and organizational roles. These domains are described in section 1.5. I further divided the domains into categories, according to the meaning units that emerged from participants' interview responses. These categories are presented and explored throughout chapters 3 and 4.

For most domains, my analysis was of a latent nature. Although my focus was on the underlying meaning of participants' responses, I strived to keep as close as possible to participants' own words, concepts, and interpretations. However, my analysis of the "observed climatic and environmental changes" domain was of a manifest nature. The goal pertaining to this domain was to describe observed changes, not to explore their meaning. I also incorporated some quantification through the use of NVivo 12 and the counting of generated categories. This was useful to identify which themes were repetitively brought forward by a plurality of research participants. This semi-quantitative approach, however, was secondary to a qualitative analysis of the relevance of inductively emerged patterns. I present this quantification in sections 3.1 and 4.1 for one specific domain (observed climatic and environmental impacts). Given that analysis of this domain was manifest and not interpretive in nature, I found it more useful to present quantification for this domain as a potential indicator of category relevance.

2.3. Additional Measures and Limitations

Research methods and data analysis share limitations with other participant-based and qualitative research methods. Additional limitations stem from the nature of the research design and recruitment methods. Limitations regarding research validity and replicability were addressed and mitigated throughout the research process, but were not eliminated.

There are limitations inherent to any research design employing data collection with research participants. Social interaction between participants and researchers invariably shapes collected data to such an extent that "the researcher can never be certain that the method of data collection provides data that capture the real context of the informants." (Bengtsson 2016, 10–11) Given that the research methods used in this

study are intrinsically based on forms of human communication, there is always the potential for what the participants express and what the researcher understands to differ. Some participants may purposefully not provide all information that they possess. Others may have difficulty expressing themselves fully. Participants' responses can also be influenced by their preconceptions of the researcher's judgments or wishes (Berg 2009).

These limitations are inherent to this study. During the research process, however, I incorporated certain measures to reduce potential biases. During data collection, whenever possible, I asked participants to clarify their replies when these were vague or when I was not sure what they meant by a particular response. Below is an example from an interview excerpt (Carrielynn Victor, pers. comm., November 23, 2017):

> RESPONDENT. So I don't have a way of knowing why some plants are leaving. But in some cases my first guess is climate change.
>
> INTERVIEWER. Which plant was that that you talked about?
>
> RESPONDENT. The blue elderberry is moving east. And labrador tea is becoming less available in the bogs.

In the subsequent data analysis process, if any responses were still vague or unclear to me, I strived either not to include these in the content analysis, or not to interpret the underlying meaning of these responses. This was also the case for certain specific topics that emerged, but that could not be further explored given interview time constraints, or that extrapolated the scope of the research project. For example, Cheryl Pailzote (pers. comm., May 24, 2017) provided additional details on tribal water supply that were technical and difficult to integrate into the content analysis. Hence, some of this content was not coded.

If, during the course of the interview, I arrived to an interpretation of something the participant said, I would ask them to verify my interpretation. These measures were undertaken to increase study replicability. The following interview excerpt (Ernie Victor, pers. comm., July 26, 2017) exemplifies this measure:

> INTERVIEWER. So what you mean is that these changes are an opportunity for people to become more adaptable, or to follow nature in a better way, in a closer way?
>
> RESPONDENT. That is definitely what I was saying in a broader sense.

Regarding the participant-researcher interaction, I strived to create an environment of trust by explaining the research design and objectives and by referring to the participant consent form before the beginning of each interview. I also deem that participants' connections to the case study organizations likely induced participants to be more inclined to share information with me.

I also consider that these connections likely influenced research outcomes in other ways. As described and quantified in section 2.1, a portion of participants were internal to the organizations. Meanwhile, most external participants were referred to me by (internal) collaborators. Although this was the most appropriate research design for the specific research objectives, connections between participants and the organizations are likely to have influenced the collected data. I deem that said connections hold the potential to (i) create a biased pool of participants that endorse values and views similar to those of participant organizations, and (ii) constrain participants from sharing certain information or opinions regarding the participant organizations.

It is important to note that not only the sample of participants, but also the research design and primary objectives, were developed in collaboration with the participant organizations and are, therefore, organization-centered. Although I compare the two case studies and discuss common findings in chapter 5, none of the results achieved in this study should be understood as a thorough representation of Stó:lō First Nations, or of the White Mountain Apache Tribe. Research results represent a partial view of the inquired topics from an organizational standpoint.

Lastly, an additional limitation is the study of Indigenous issues from a Western-based methodology and perspective. However, as a non-Indigenous person, I do not believe I would have the capacity to legitimately apply Indigenous methodologies, nor to fully represent Indigenous worldviews and perspectives. To avoid or lower misinterpretation and misrepresentation, I strived to maintain my data analysis close to participant responses' surface, expressed content, and to include interview excerpts whenever possible in the presentation of results (chapters 3 and 4).

Chapter 3.

Results and Recommendations: SRRMC

I divide this chapter in six sections. I begin by presenting the results from the domains that comprised the content analysis: observed climatic and environmental changes, reported cumulative effects on Stó:lō communities, identified adaptation actions, adaptation opportunities, and organizational roles. The final section summarizes lessons learned from the case study results and drafts recommendations for organizational support of community adaptation. The relationships between domains and research objectives are described in section 1.5.

I strive to describe the content analysis based solely on participants' semi-structured interview responses. I allow for more researcher subjectivity in section 3.6, where I further analyze the links between the different domains and what conclusions and recommendations can be derived therefrom.

3.1. Observed Climatic and Environmental Changes

This domain refers to changes that participants have observed in the climate and the natural environment of their traditional territories and which they deem possibly caused by global climate change. I refer to these changes as "impacts," as they are directly connected to the effects on communities described in section 3.2.

I categorize these impacts in four categories: Fraser River, traditional resources, increased risks, and climate and seasonal patterns. Participants' observations indicate that many of these impacts are interconnected; however, they are here divided into four categories for visualization purposes. Due to such interconnections, many relevant interview excerpts refer to multiple impacts. Therefore, I present the interview excerpts that best describe not only the impacts but also the interconnections among them, instead of organizing excerpts by individual impact.

The impacts are displayed on tables 3, 4, 5, and 6 according to the number of participants who referred to each impact. However, this does not constitute a

quantitative analysis, given that data collection methods were qualitative and participants were not systematically questioned about each impact.

Fraser River

Table 3.1 depicts impacts related to the Fraser River. Participants perceive Fraser River water levels to have become lower in recent years. This might be related to reported decrease in snowfall and in local mountain snowpack, which leads to lower water levels during freshet times. Lower Fraser River water levels comprise one of the factors restricting access to fishing. Participants also perceive lower water levels to be affecting salmonid populations:

> It [Fraser river] has been so low for a number of years now . . . five or six years now. . . . I think a lot of that has to do with the amount of snowpack up in the mountains. And usually, during freshet times, we are able to fish certain parts of the river when it is high water . . . but lately we haven't been able to get out there because the water is so low. . . . We are seeing impacts on the runs of fish in the following years. This year the fishing was just terrible, there was no fish, no sockeye. It seems almost like all the runs are in trouble now. (Joseph Anthony "Tony" Dandurand[3], pers. comm., September 27, 2017)

Fraser River water levels are not only lower, but also more variable, which leads to lower water quality:

> The river rose quicker and it stayed higher this year for an extended period of time. So, this tells me that there is a snowpack and it melted fast and it rushed out. . . . The river is usually at, rises six feet and stays six feet, when I was younger, for ten days, and then it kind of goes down to the two, three foot level and it stays there for predominantly all the summer. Right now what I am noticing is the river rose to six feet, stayed for two weeks, maybe longer, and now is dropping below the two feet, it is down to one foot, so there is less water. (Ernie Victor, pers. comm.)

> And in the last four years I noticed more fluctuations, faster changes in water levels. And then of course the quality changes as well. Because when water moves more quickly, it picks up more debris along the way, so the water quality is actually more turbid. (Carrielynn Victor, pers. comm.)

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[3] From here on referred to as Joseph Dandurand.

Warmer Fraser River temperatures are also perceived to be related to decline in snowfall, and to exert detrimental effects on salmonids and other species:

> The river itself is becoming a lot warmer, and it has an impact on our fish and other species, animals that depend on the river. So again we have to, it is related to the snow levels that come to our mountains, but also to other mountains that are further inland and if there is not enough snow there, it is why it has an impact on the river out here. (Clarence "Kat" Pennier [4], pers. comm., September 21, 2017)

Table 3-1.   Fraser River

Impact	Number of references
Warmer Fraser River temperatures	6
Lower Fraser River water levels	6
Lower snowfall	3
Lower snowpack	3
More variable Fraser River water levels	2
Lower Fraser River water quality	1

Traditional resources

Table 3.2 depicts impacts related to resources that are traditional to the Stó:lō. Participants perceive overall decline in salmonid populations. Variation in impacts to different salmonid species and populations were not thoroughly explored. Participants identify Fraser River warming as one of the causes for such decline:

> It seems like the warmth is having an effect on the temperature of the river too, an effect on the fish. Because back in the mid-90s I used to catch way more fish than I do now. . . . [Salmon] in general it seems like. (Naxaxalhts'i, Albert (Sonny) McHalsie [5], pers. comm., July 24, 2017)

> There are three years out of the four years now that have been pretty low in terms of returning number [for sockeye salmon]. . . . We don't really know what contributes to this, some suspect it is ocean conditions, predators intercepting these fish as well. And perhaps water is too warm for them. We know when they return back to spawn, the river temperatures have elevated. Ideally for salmon, ideal water temperatures are around sixteen to seventeen degrees. And this river warms up to twenty degrees plus, so those fish might not come back to spawn. (Murray Ned, pers. comm., September 21, 2017)

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[4] From here on referred to as Clarence Pennier.

[5] From here on referred to as Sonny McHalsie.

Because of its "unique conditions" for salmon preservation, the Fraser canyon has been a site for the practice of wind-dried salmon since time immemorial (Butler 1998, 1). This method of salmon preservation was an essential component of Stó:lō (and other First Nations) diet until the twentieth century, when governmental fisheries regulations began to "drastically" reduce Stó:lō participation in wind drying (Butler 1998, 1). Decline in salmon populations is one factor that is currently leading to restricted access to fishing, including restrictions to the traditional practice of wind-dried salmon:

> Not many openings on spring salmon and when we do get an opening it is a small opening, only like eighteen hours. And at least this year we had a few openings but last year we didn't have any openings, so. And of course with the sockeye, no openings on sockeye and it is already July 24th. . . . In the beginning of July people should be out drying salmon, but with the restrictions we don't get out there. (Sonny McHalsie, pers. comm.)

Participants are also perceiving changes in timing of salmonid returns:

> Fish . . . are coming back in different periods, or they are not coming back in abundance. . . . Chinook [salmon] . . . we are not seeing the same abundance in returns in February and March. Much of the fish that are coming in are much later, maybe a month or two late. So we are seeing more abundance probably in May to August. So there is a shift in terms of when they are returning and how many are returning. (Murray Ned, pers. comm.)

An increase in diseased salmonids has also been perceived by some participants. It is unclear if this is related to climate change:

> The last five or seven years, some of the salmon that come up have sores on their bodies. I wouldn't know exactly, but I am assuming that is from the pollution. (Maretta Beger, pers. comm., July 18, 2017)

> The fish get sick because they are too hot. I poked my finger through a fish, I pulled a fish out of the water in my net and reached in to grab it and my fingers went through the flesh. (Carrielynn Victor, pers. comm.)

Participants observe that local wildlife has become less available in the territory. It is unclear if this is related to climate change:

> We have been noticing is the gradual decline in our animals in the area. Some of it may be related to climate change. . . . I know we used to have a lot of different species in Sq'éwelets, like muskrats and beavers and part of those disappeared when the government decided to put dikes along the river. . . . We notice that the number of our deer are decreasing quite a bit. (Clarence Pennier, pers. comm.)

Wild berries and other traditional plants and medicines are becoming less available or changing their distribution within the territory:

> We have to drive . . . really far away for certain plants. . . . Sometimes, the foods and the medicines that I am looking for exist in really rare ecosystems. . . . Some things are becoming less available or moving farther away. . . . I don't have a way of knowing why some plants are leaving but in some cases my first guess is climate change. . . . The blue elderberry is moving east. And Labrador tea is becoming less available in the bogs. (Carrielynn Victor, pers. comm.)

> This one berry that has medicinal properties, they used to be able to get it throughout Chilliwack, and now they have to go up past Hope and it only grows in a very short window of time. And it has been decimated by invasive species and drought. (Shana Roberts, pers. comm., July 25, 2017)

Participants observe certain traditional plants to be less healthy due to warmer summer temperatures and drier conditions:

> I do some plant harvesting for food and medicine. . . . And some plants . . . suffer in the hot dry summer. And I have never seen them suffer as they did in the last two years. . . . And the cedar trees will self-sacrifice any needles underneath that they don't need so that all of the ones on top can do the work. So, they are stressed. (Carrielynn Victor, pers. comm.)

> When we go into the natural world, we are quite concerned with some of the trees that are suffering from the lack of water in the summertime. We can tell that the vegetation in the forest is quite stressed. (Eddie Gardner, pers. comm., July 28, 2017)

Table 3-2.   Traditional resources

Impact	Number of references
Decline in salmonid populations	9
Decreased availability of traditional plants and medicines	5
Changes in timing of salmonid returns	3
Changes in distribution of traditional plants and medicines	2
Less healthy traditional plants	2
Decreased availability of local wildlife	2
Diseased salmonids	2

Increased risks

Table 3.3 depicts other impacts that may pose increased risks to Stó:lō communities, such as extreme weather events. Participants observe drier and warmer

summer conditions as leading to increased threats of wildfires in British Columbia. BC wildfires, depending on their location, can lead to lower air quality in the Fraser Valley:

> In the summer and fall, seems to be much drier, the threats of forest fires are increasing now. . . . We recently had our valley filled up with smoke because of fires in Harrison River in this summer already. (Eddie Gardner, pers. comm.)

Global climate change increases risk of flooding in Stó:lō communities:

> Flooding is a real fear, real worry on many of the reserves. . . . The communities that are at risk for flooding want to build up dikes and protect their areas. (Shana Roberts, pers. comm.)

Participants observe ice storms to be leading to power outages in Stó:lō communities (Carrielynn Victor, pers. comm.; Taylor, pers. comm., July 24, 2017). One participant observes an apparent combination of ice storms and rain-on-snow events:

> But the rain on ice on snow event seems like a new. . . When this freezing rain comes down and forms ice blocks around an entire tree, and then it pours rain, because it warms up so fast that the trees crack under the pressure, it is strange to me. (Carrielynn Victor, pers. comm.)

Participants are also observing a recent increase in insects in Stó:lō communities:

> One of the things that is really prevalent this year is the number of bugs. There are more horseflies, lots of mosquitoes and lots of wasps. And the mosquitoes, for one of the communities, they are like, "We can't even go outside. We go outside for two minutes and we are covered in mosquitoes." (Shana Roberts, pers. comm.)

Table 3-3.   Increased risks

Impact	Number of references
Insect proliferation	3
Increased risk of floods	3
Increased threats of wildfires	2
Lower air quality due to wildfires	2
Ice storms	2
Rain-on-snow events	1

Climate and seasonal patterns

Table 3.4 depicts observed changes in local climate and seasonal patterns. Warmer and drier summer conditions are mentioned in interview excerpts in the last two sections. These impacts are not further detailed by participants.

Carrielynn Victor (pers. comm.) explains how seasonal winds are shifting and becoming less persistent in their occurrence, and how these phenomena relate to Stó:lō culture. She also perceives the weather to be less predictable in general:

> The weather often is more unpredictable. . . . The wind is a little different as well. Typically this time of year our ceremony pays close attention to wind direction and we have names for the wind directions. We'll say that a different spirit comes in from different directions based on how it feels and what type of energy comes with the winds. . . . It is quite predictable. Right now we are seeing wind from the northeast one day, and then wind from the west another day. And then . . . a week of icy cold weather, and then a wind from the south comes and warms it all up. It is quite strange. (Carrielynn Victor, pers. comm.)

Table 3-4.   Climate and seasonal patterns

Impact	Number of references
Warmer summers	3
Drier summers	2
Less predictable weather	1
Less persistent winds	1

3.2. Reported Cumulative Effects on Collective Stó:lō Community

Reported cumulative effects on the collective Stó:lō community comprise the effects that participants report as deriving from the climatic and environmental changes described in section 3.1. To a lesser extent, some participants also mention ways in which Stó:lō communities may be affected in the future, given current climatic trends and knowledge of projected climate change effects.

I display these effects according to three categories: impacts to Fraser River salmon populations, impacts to traditional resources, and other impacts. This categorization highlights the drivers behind the effects experienced by Stó:lō communities. My objective is to draw attention to the magnitude and diversity of effects that changes in traditional resource health, abundance, distribution, and seasonal

patterns exert on Stó:lō communities. Of these traditional resources, impacts to salmonids play a central role in the effects identified in this study.

Effects within the first category comprise those that are exclusively related to impacts to Fraser River salmon populations. The second category (impacts to traditional resources) includes the remainder of effects related to shifts in traditional resources that are not exclusive to Fraser River salmon populations.

During the analysis, it became clear that some of the effects are impacting Stó:lō communities in multiple ways. I address this by further categorizing the themes that surface in participants' discourses into seven dimensions: health, food security, financial security, cultural practices, spiritual connections, cultural identity, and traditional knowledge. As shown in table 3.5, the effects are in this way cross-referenced with these seven dimensions. One could argue that all of these dimensions are interrelated to some degree; however, I deem that this categorization further clarifies the specific ways in which Stó:lō communities and their members are being affected by change in climate, and by environmental change more broadly.

Effects are linked to different affected dimensions based on information disclosed by research participants. For example, any detrimental impact to Stó:lō cultural practices could potentially affect traditional knowledge transfer. Nonetheless, effects are only linked to traditional knowledge where explicit links are drawn by participants. More importantly, neither the listed effects nor the affected dimensions identified here intend to be exhaustive. Not all of the identified impacts in section 3.1. were fully investigated in their consequences to communities.

Table 3-5. **Reported effects on collective Stó:lō community and affected dimensions**

Impacts to Fraser River salmon populations	Impacts to traditional resources	Other impacts
Depriving "Salmon People" of salmon Health Cultural Identity	**Traditional foods scarcity** Food Security Health Financial Security Cultural Practices Spiritual Connections	**Environmental changes hinder cultural practices** Cultural Practices
Less access to fishing Cultural Practices Cultural Identity	**Reduced Stó:lō well-being** Health	**Changes in seasonal indicators affect timing of ceremonies** Cultural Practices Traditional Knowledge
Lower incomes for fishers Financial Security	**Resources less available for traditional uses** Health Cultural Practices	**Reduced air quality** Health Cultural Practices
Changes to First Salmon Ceremony Cultural Practices Spiritual Connections	**Decline in intergenerational knowledge transfer** Cultural Practices Traditional Knowledge	**More frequent power outages** Food Security
	Effects on people's *Shxwelí* and on spiritual connections Cultural Identity Spiritual Connections	

Impacts to Fraser River salmon populations

This section describes reported effects stemming from decline in salmonid populations, changes in timing of salmonid returns, and diseased salmonids.

Depriving "Salmon People" of salmon

The Stó:lō are Salmon People (Cameron 1997); they are "fish in essence" (Murray Ned, pers. comm.). Salmon and the Fraser River are at the heart of Stó:lō self-identification as a people, and comprise fundamental aspects of Stó:lō cultural practices and spiritual connections (Cameron 1997; Carlson 2001a; Smith 2001). Salmon has also been the main staple in Stó:lō diet since time immemorial, which is confirmed by studies

of ancestral skeletal remains. Such studies reveal that marine protein traditionally comprised about 90% of Stó:lō diet (Smith 2001, 120). It is unclear what health effects could stem from lack of salmon in Stó:lō diet:

> We are fish people. We have always been fish people. What happens when there is no fish, what do we turn to? What are our bones made up of? . . . When our bones and our blood and our memories are made up of fish and they are not available. (Carrielynn Victor, pers. comm.)

Disappearance of salmonids from the territory is described as a disastrous possibility for the Stó:lō. Being Salmon People, the Stó:lō not only share a "close kin relationship" with salmon (Harper 1997, p. 154), but also identify with salmon as an integral part of Stó:lō identity: "If we lose our wild salmon . . . as the salmon goes, so do we. It is as simples as that." (Eddie Gardner, pers. comm.)

Less access to fishing

In 1990, the Supreme Court set important precedents for Aboriginal (fishing) rights in *R. v. Sparrow*, as it concluded that members of the Musqueam band had an Aboriginal right to fish, particularly for Food, Social, and Ceremonial (FSC) purposes. The Court also ruled that Aboriginal fishing for such purposes should be allocated priority, after conservation requirements (Asch and Macklem 1991). In order to fish for FSC purposes, communities need to obtain Communal Licences, which are issued by the Minister of Fisheries and Oceans. Communal fishing licences may specify fishing area, times, species, allocations, methods, or other restrictions (DFO 2013). Hence, decline in salmonid populations leads to various restrictions to Aboriginal fishing.

Fishing is traditionally an integral aspect of Stó:lō lifeway and economy (Cameron 1997; Macdonald 2018). There have been profound changes in access to fishing during the past decades, as Murray Ned (pers. comm.) recollects, "We could fish three to four days a week with my dad and others in the community . . . every week for the entire year. Now our fishery is down to hours in a day, sometimes a weekend, a few weekends in the year."

Not being able to fish equals a loss in cultural practices and an impact to a way of life. Joseph Dandurand (pers. comm.) states that his and other Stó:lō families are being impacted by lack of fish, which constitutes an exceptional circumstance for Stó:lō way of life. Adaptation to such a circumstance might be limited:

It is incredible to see that [lack of fish] happen. I don't know what we do because we are river Indians, you know, we are all fishermen and we all live on the river and the river has always been our food source for thousands of years now. (Joseph Dandurand, pers. comm.)

There has also been a decline in the practice of wind-dried salmon, as the dry rack season is restricted due to conservation purposes:

It has been the same for ten, fifteen years now, I think. I think it was about three or four years ago . . . [that] quite a few elders as far as I know missed out on the dry rack opening because they only gave four days. So it has been like that way for a while, it is mainly because of . . . concern for the Stuart run. And that is the fish that is running right at that time, when the dry rack is opened. (Sonny McHalsie, pers. comm.)

Lower incomes for fishers

For certain fisheries (e.g., Fraser River sockeye salmon), Oceans and Fisheries Canada (DFO) only opens commercial harvest opportunities if salmon returns are sufficient to meet (i) conservation objectives, and (ii) Aboriginal FSC fisheries' needs (DFO 2014). With declining salmonid populations, community members who rely on commercial fishing are being financially affected by restrictions in harvest opportunities:

I think those people who rely economically on the fishery are already noticing drastic changes. . . . And it is trying on all the rest of the pockets, well-being, social, ceremonial, it changes everything. (Carrielynn Victor, pers. comm.)

Changes to First Salmon Ceremony

According to McHalsie (2007, 92–93), *Sxwóxwiyám* are oral histories that describe the time when "Xexá:ls, the Transformers, travelled to our land to make the world right. . . . They travelled from the head of Harrison Lake down to the Fraser, up the river to the sunrise, through the sky to the sunset, and back upriver again." *Xexá:ls* transformed a then chaotic world into its present form. They punished people that were responsible for chaos, some of which were turned to stone, and transformed other people into valuable resources, such as western redcedar and salmon. Sites and resources that are involved in these stories are sacred to the Stó:lō (McHalsie, Schaepe and Carlson 2001; McHalsie 2007; Stó:lō Nation 2003a).

The First Salmon Ceremony is an annual ceremony for maintaining Stó:lō people's ancestral and reciprocal connection with salmon (McHalsie 2007). It involves

the re-enactment of an *Sxwóxwiyám* that tells the story behind the annual return of salmonids to Yale. According to this *Sxwóxwiyám*, men that were transformed into birds, together with Beaver and Rat (Mouse, depending on the version), captured the sockeye baby from the ocean, threw its diapers in different places, and brought the sockeye baby up to Yale (McHalsie 2007, 90–91).

Because of this *Sxwóxwiyám*, people conduct the annual First Salmon Ceremony, so that the bones of the first salmon are returned to the water. The ceremony involves collective sharing of the first caught salmon, saying of prayers to the salmon people, and return of salmon bones to the river by one of the chiefs, one spiritual person, one elder, and one youth (McHalsie 2007, 91). Eddie Gardner (pers. comm.) further describes the First Salmon Ceremony as follows:

> Because we relate to salmon as our relatives, we acknowledge them every year. . . . The most powerful way we do that is through ceremony, we have our salmon songs. And they say that every year in the spring time, when the first salmon comes, the fisherman that catches the first salmon, they need to bring that salmon into the longhouse, and invite as many people as possible to come and share the salmon. . . . And offer the remains of the salmon back into the water, with the message that we thank the salmon people, we thank the salmon spirit for continuing the cycle. And the old ones always told us that if we ever stopped doing that, we would have no more salmon.

Changes in timing and abundance of salmon returns alter community members' access to fishing and the timing of the First Salmon Ceremony. The ceremony was usually conducted during February and March, when the first chinook and spring salmon are returning (Murray Ned, pers. comm.). Recently, the Stó:lō have only been able to perform the ceremony in May or June, when fish are more abundant (Murray Ned, pers. comm.). Such changes can be detrimental to the connection with the first salmon:

> Now science has, the first fish is here, and then time passes, the first fish has gone through, now we go tell our fishermen that they can catch the first fish. But the first fish has already gone through. . . . We take the first fish because it is responsibility . . . it is an honouring a relationship between the people and the first fish. And that first fish feels like it is wanted, right. It belongs. (Ernie Victor, pers. comm.)

Impacts to traditional resources

This section describes reported effects stemming from impacts to traditional resources, including but not exclusive to Fraser River salmon populations.

Traditional foods scarcity

Many traditional resources serve the function of traditional food sources (Garibaldi and Turner 2004; CIER 2008). Research participants' responses indicate that traditional foods scarcity within Stó:lō traditional territory (*S'ólh Téméxw*) is exerting negative effects on community members' health, food security, cultural practices, and spiritual connections with ancestors. The need to purchase more store-bought foods can also have negative financial effects on Stó:lō households.

Decline in salmonid populations and in other traditional resources availability (e.g., wild game, berries) are one of the drivers of changes in Stó:lō traditional food habits. Traditional food consumption has decreased in Stó:lō communities, including consumption of foods and medicines that are useful in combating or preventing health issues. As Carrielynn Victor (pers. comm.) explains, "Seasonally it is a preventative measure to indulge in one of those teas or one of those foods, to boost your system in order to get through the season."

With decrease in traditional food consumption, store-bought foods have largely displaced traditional foods. Risks to health do not only stem from the loss of specific health benefits of traditional foods, but also from the fact that such store-bought foods are frequently unhealthy. These changes are contributing to health problems in Stó:lō communities:

> Our dependence on Safeways, we go there to buy all our food and we used to depend on food from the land and the water. . . . How do we get back to that? And it is expensive, and our people are poor, can't really afford it. It is why we go to the McDonald's and the A&Ws, because food is cheap, but it is fattening. It affects our people with obesity and diabetes and all those kind of things, so health concerns. (Clarence Pennier, pers. comm.)

Decline in salmonid populations are negatively affecting Stó:lō FSC fisheries (Joseph Dandurand, pers. comm.). Salmon catches comprise traditional food sources necessary for ceremonies and winter gatherings, as well as for community members' sustenance (Cameron 1997). According to Joseph Dandurand (pers. comm.), decline in

salmon populations "definitely affects us in regard to our food fisheries and how we sustain ourselves in the winter months by catching what comes in the summer."

Substituting store-bought foods for wild salmon constitutes an added expense that can be financially challenging for households. Additionally, stronger reliance on such foods implicates being vulnerable to market fluctuations, to climate change effects on global food production, and to Western society and its potential crises (Clarence Pennier, pers. comm.; Carrielynn Victor, pers. comm.). Overall, food security is decreased by traditional food scarcity.

Store-bought foods are also replacing traditional foods in ceremonies. This is an undesired change to traditional practices and ceremonies and is viewed upon as a negative situation:

> When we are doing these ceremonies now, you might get one or two fish if you are lucky. . . . And then you might have to feed your community something else besides fish. So again, it is part of the tradition that is being lost. And it is a pretty sad day when you can't feed your community what we are used to traditionally. (Murray Ned, pers. comm.)

Sharing traditional foods in ceremonies also comprises a form of connection to resources and to ancestors' spirits. Therefore, lack of traditional foods incorporation into ceremonies can negatively affect Stó:lō people's connection to ancestors:

> My community . . . whenever we have our ceremonies in the spring and the fall. . . . We feed our ancestors' spirits, because we come from the sturgeon, or close relation to the sturgeon, we have to serve sturgeon at those ceremonies. Because we feed our ancestors with burned food in the fire, and so we always make sure. (Sonny McHalsie, pers. comm.)

Resources less available for traditional uses

Decreased availability of traditional resources in the territory, as well as changes in their geographical distribution and seasonal availability, restrict community members' access to these resources. Restricted access limits the use of these resources in gatherings and ceremonies, for their medicinal properties, and for other traditional uses. Participants express concern regarding potential climate change effects on resources that are needed for specific ceremonies:

> It is challenging to imagine how our ceremonies might shift and change if the cedar tree is impacted. . . . The trees are just dying from inside out.

. . . If we need certain trees for certain ceremonies, how do these ceremonies change? (Carrielynn Victor, pers. comm.)

Decline in intergenerational knowledge transfer

Decreased access to traditional resources consequently reduces access to the teachings associated with these resources. It is more difficult for community members to teach younger generations when resources or the cultural practices associated with them are less accessible (Carrielynn Victor, pers. comm.). This constitutes a threat to traditional knowledge developed over thousands of years of connections with resources:

> Because if we can't practice fishery . . . we can't pass on the knowledge and the education to the next generation. So there could be a lost form of traditional practices. . . . There is an interest in fishing but it is not as strong as it once was because there is not as much of the resources to go out and practice the fishery. (Murray Ned, pers. comm.)

Reduced Stó:lō well-being

As described in *Sxwóxwiyám*, certain traditional resources were originated from transformations to Stó:lō ancestors (McHalsie 2007). The Stó:lō are spiritually connected to their ancestors (McHalsie 2007, 108; Carlson 2001a). Ancestor health and well-being deterioration comprises an impact to the collective Stó:lō community. Impacts to ancestors affect Stó:lō people's well-being through spiritual connections:

> And how does that [stressed cedar trees] affect not just our spiritual connections but our mental and emotional well-being that is attached to the well-being of that tree? Not to mention the physical feeling of seeing something suffer, when you know certain plants and certain animals are ancestors. When we understand that our people turned into them or came from them. (Carrielynn Victor, pers. comm.)

These connections link the Stó:lō to their cultural traditions and identity, and foster emotional well-being and stability, if they can be exercised (Ernie Victor, pers. comm.). When they cannot be exercised because the resources are impacted, people are deprived of the benefits associated with these connections:

> You can never underestimate the value of what a resource brings to keep someone solid. . . . If you are filling your time with that kind of relationship [spiritual connections], that is better than all of those negative things that we have shadowing us nowadays, like drug abuse, addictions, obesity, diabetes. . . . If you just get on this track of traditional use and have your cultural teachings behind it, that becomes your normal and less of those negative things. (Ernie Victor, pers. comm.)

Effects on people's Shxwelí (life force) and on spiritual connections

It is through discussed cultural practices (e.g., fishing, hunting, plants gathering) that the Stó:lō connect with resources in a spiritual and reciprocal way. As Ernie Victor (pers. comm.) explains, these relationships (i) involve a responsibility to connect shared by both parties, (ii) need to be maintained through time such as any other type of relationship, and (iii) affect one's life force and integrity:

> Spiritual impacts, you need to be engaged with something in order to be spiritually connected. . . . You have a responsibility to connect. The resource expects you to be there and is planning on providing for you, and has made that commitment. Now, as humans, if you are not there, you miss that connection. Therefore, you are unable to work with your own life force and gain support from that resource to support your life force. So, if you miss that, you miss a part of you.

Stó:lō people's life force (*Shxwelí*) lies in the *connections* that the Stó:lō share with other-than-human beings (Sonny McHalsie, pers. comm.). As explained by Eddie Gardner (pers. comm.), *Shxwelí* is a "life force that is in the rocks, in the trees, in the waters, in the salmon." This life force is the *Shxwelí* of ancestors that were transformed into other-than-human beings by *Xexá:ls* during the distant past described by *Sxwóxwiyám.* Although ancestors were transformed, their *Shxwelí* remains within these beings, and with it, the spiritual connection to the Stó:lō (McHalsie 2007, 108).

If the Stó:lō are restricted from maintaining these connections, this consequently affects Stó:lō people's *Shxwelí*. Sonny McHalsie (pers. comm.) emphasizes how restricted access to fishing and to fishing grounds is affecting the connection to ancestors, and with it, people's *Shxwelí*:

> It is our belief that the *Shxwelí* of our ancestors are out there on the land where they used to fish. So when we go out there and fish where our ancestors used to fish it is like we are with them, fishing at the same place. So, *Shxwelí* and *skwelkwel* are kind of tied together, *skwelkwel* is your family history. And it is stories about your ancestors, where they fished, where they hunted, where they gathered berries, and so on. So once you find out where they did those things, then you have to go out there to those places and you have to do that and then you have to take care of the place.

Other impacts

This section describes reported effects that are not linked to impacts to traditional resources.

Environmental changes hinder cultural practices

Changes in water quality and flow, in air quality, and in impaired access to specific sites can hinder and disrupt cultural practices (Clarence Pennier, pers. comm.; Taylor, pers. comm.). Diminished air quality due to recent increases in BC wildfires can hinder the practice of wind-dried salmon (Shana Roberts, pers. comm.).

Impacts to waterways, such as lower Fraser River water levels and water quality, are likewise disrupting cultural practices. According to Clarence Pennier (pers. comm.), certain cultural practices are dependent on the creeks and the waterways, and these environmental changes make "it more difficult to find the right places to do our things that we depend on the water and the creek for." This is especially the case for the use of bathing pools for spiritual practices (Taylor, pers. comm.).

Changes in seasonal indicators affect timing of ceremonies

Climatic change is affecting wind persistence and seasonal indicators that signal the beginning and ending of ceremonies. The timing of ceremonies is traditionally tied to a series of seasonal cues that follow the moon calendar:

> There are three symbols for the changing of the season that mark the beginning of ceremony. One is the snow on this mountain every year. . . . And the second thing is, when the leaves are done falling off the trees. . . . But what happened this year is that leaves on the trees died of thirst before they had time to grow old. So they just went stiff and fell off. . . . And then the third is the tree frogs . . . they have a phenological cue. So the frogs will sing through September into October, late November, and then they stop . . . and then in February, early March, the frogs start singing again. . . . So, start [ceremonies] when the frogs stop, and stop when the frogs start. This year, one frog. One. I heard one frog and normally they are everywhere singing, so loud. (Carrielynn Victor, pers. comm.)

However, with change in climate, the timing of ceremonies is being increasingly disconnected from seasonal patterns and from traditional knowledge associated with such patterns. Stó:lō people are progressively following the Western calendar for the timing of their traditional ceremonies. Hence, younger generations are not learning the

traditional calendar and are not connecting with seasonal patterns, which in turn disrupts intergenerational knowledge transfer:

> Collectively we haven't reassessed what aspect of ceremony belongs where when the snowline is unpredictable. . . . It should impact the timing of the ceremonies, but . . . a lot of our people are going by a calendar instead of looking to the snowline. . . . So, we will see young people who, maybe they don't know these things. And maybe all they know is the calendar, and that is quite different. (Carrielynn Victor, pers. comm.)

Reduced air quality due to wildfires

Wildfire activity was increased in British Columbia's 2017 wildfire season, reaching 1.2 million hectares burned[6]. Risk factors for 2017 wildfire events (e.g., extreme warm and dry conditions) have been correlated to global climate change (Kirchmeier-Young et al. 2019). Wildfires in BC have resulted in lower air quality in the Fraser Valley, which in turn exerts health effects on Stó:lō communities:

> All that smoke that came from the wildfires, the Fraser Valley is actually really susceptible to any sort of increase in pollutants. . . . So you can see in elders, and children, and people with breathing disorders, you can see them struggling. (Shana Roberts, pers. comm.)

For low air quality effects on Stó:lō cultural practices, see Carlson (2009).

More frequent power outages

Some participants express that severe weather events, such as ice storms and rain-on-snow events, might be increasing in frequency. Such events frequently result in power outages in Stó:lō communities:

> Recently seeing a rain on ice on snow event every year and it really affects, the branches on the trees all snap off and make a big mess. . . . Freezing rain, snow, freezing rain, pouring rain, water everywhere. Melting snow and broken trees. And we will go days without power. . . . The trees will crack on top of the power lines on five certain spots and it will take days for the power lines to come back on. (Carrielynn Victor, pers. comm.)

Power outages have detrimental effects on food preservation, as well as potential health effects that were not explored in this study. Communities that experience lasting

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[6] Most of my data collection was conducted prior to the extreme wildfire seasons of 2017 and 2018. I expect effects of lower air quality to be potentially broader and more impactful than what is described in this study.

power outages risk losing game meat and other traditional foods that are harvested and preserved to last throughout seasons (Taylor, pers. comm.).

3.3. Identified Adaptation Actions

Stó:lō community members are identifying environmental changes and adapting accordingly to maintain continuity in their cultural practices and identities. As cumulative effects lead to shifts in ecological communities and change the geographical distribution of resources, community members are dislocating farther in the territory to gather traditional plants and mushrooms and to hunt wild game (Carrielynn Victor, pers. comm.; Murray Ned, pers. comm.; Shana Roberts, pers. comm.). Changes in seasonal patterns similarly lead community members to adjust the timing of their cultural practices, including of certain ceremonies, to be able to access resources, such as Fraser River salmon (Ernie Victor, pers. comm.; Murray Ned, pers. comm.). Other environmental changes, such as changes to waterways needed for cultural practices, also lead community members to adjust the location or timing of their practices (Clarence Pennier, pers. comm.).

Some participants mention the development of plant inventories and greenhouses for traditional plants and medicines as possibilities for future action (Shana Roberts, pers. comm.; Sonny McHalsie, pers. comm.). It is unclear if this is ongoing in any Stó:lō communities or solely being considered at this point. Stó:lō stewardship of traditional use areas and resources can be considered an adaptation that is paramount to resource harm mitigation, as well as to assertion of Aboriginal rights and title (Eddie Gardner, pers. comm.).

Regarding salmonid populations in specific, Stó:lō communities and organizations are involved in wild salmon conservation advocacy—the Stó:lō and other First Nations groups act as leaderships in the quest for wild salmon conservation. Political advocacy is particularly exerted through Stó:lō resistance against farmed salmon in British Columbia (Eddie Gardner, pers. comm.). Stó:lō respect for governmental measures that restrict their own access to fishing stems from their support of salmon conservation (Joseph Dandurand, pers. comm.). Additionally, the Stó:lō are part of First Nations organizations such as the Lower Fraser Fisheries Alliance (LFFA), which promotes fisheries management that integrates interests and viewpoints across

First Nations in the lower Fraser River and develops projects to mitigate harm to salmonids. The LFFA is currently working on the Lower Fraser Climate Adapt project to support communities in adapting to climate change effects to Aboriginal fisheries, with a special focus on flooding impacts (LFFA, n.d.). This project includes mapping of First Nations environmental and cultural values to develop a risk and vulnerability assessment (LFFA, n.d.).

As traditional food sources become less available, store-bought foods are increasingly displacing traditional food security (Clarence Pennier, pers. comm.; Sonny McHalsie, pers. comm.). This includes the purchase of fish as a substitute to the practice of fishing (Maretta Beger, pers. comm.). Another adaptation includes the sharing of caught fish with extended family (Maretta Beger, pers. comm.), which can be thought of as an interpersonal food security network.

More recently, eight Stó:lō communities have engaged in climate change adaptation planning in conjunction with the SRRMC as project manager (Shana Roberts, pers. comm.). The SRRMC secured funding for this project from the federal First Nation Adapt Program (Canada 2018). Other Stó:lō communities are pursuing adaptation planning through this funding stream independently of the SRRMC (Canada 2018). Stó:lō First Nations are also involved in flood management through representative participation in the Lower Mainland Flood Management Strategy (LMFMS), managed by the Fraser Basin Council (FBC, n.d.), as well as through independent flood assessment and mitigation projects (Canada 2018).

Stó:lō First Nations are also partnering with other Coast Salish First Nations and U.S. tribes in an annual Coast Salish Gathering (Murray Ned, pers. comm.). This gathering is a response to environmental challenges to the Salish Sea that are threatening Coast Salish resources and way of life ('About the Gathering' n.d.). These events provide a platform for First Nation Chiefs, U.S. tribal leaders, and Canadian and American governmental agencies to dialogue and reach shared understanding and solutions for the Salish Sea ('About the Gathering' n.d.).

One participant mentions that actions that prepare for or mitigate climate change effects are not being consistently thought of as "climate adaptations" in the collective Stó:lō community (Taylor, pers. comm.). I deem it likely that Stó:lō communities,

organizations, and community members are exerting adaptive capacity in other ways, but that (i) these are not being announced as "climate adaptations," or that (ii) I did not come into contact with community members that were informed about them. Hence, the adaptation actions identified here are not exhaustive. Table 3.6 presents identified adaptation actions that are currently being considered, planned, or implemented in Stó:lō communities.

Table 3-6.   Identified adaptation actions

Addressed areas	Adaptation actions
Traditional resources & cultural practices	Adaptation of cultural practices to environmental changes Traditional use area and resource stewardship Traditional plants management
Fraser River salmon populations	Wild salmon conservation (political advocacy for/support of) Integrated fisheries management Lower Fraser Climate Adapt
Food security	Diversification of food sources Food security networks
Flooding	Participation in flood management decision-making
Multiple impacts	Adaptation planning Coast Salish Gathering

3.4. Adaptation Opportunities

Adaptation opportunities are understood here as actions that enable community adaptation (Klein et al. 2014) or that support community adaptive capacity.

Cooperation within Stó:lō community

Colonialism has had deep negative effects on Stó:lō people that are still present today. Colonial governments started to misappropriate Stó:lō territory according to settler society interests in the 1850s, during the so-called Fraser River Gold Rush (Carlson 2001c; Tennant 1990). The Stó:lō were confined to small tracts of land (Indian reserves) that are diminutive compared to their traditional territories. Moreover, this was carried out in the absence of treaty-making (Carlson 1997a).

Indian reserves restricted the Stó:lō from access to the most productive and suitable lands, which were historically expropriated for settler use. Stó:lō people were often forced to live on floodplains (Murray Ned, pers. comm.). Additionally, reserves have contributed to how Coast Salish people self-identify. Band designation, in

particular, has fostered divisiveness where it did not previously exist (Clarence Pennier, pers. comm.; Shana Roberts, pers. comm.; Stephen McGlenn, pers. comm., September 14, 2017). Stephen McGlenn (pers. comm.) describes how band designation has affected the Sema:th First Nation:

> Before the Indian Act, Leq'á:mel and Sema:th were one and the same tribe. . . . When the reserves were created, they decided to split them into two different Chief and Councils, because of the geographic separation from the river. So all the historic, thousands of years of family connections were suddenly severed between the two communities. And we are sort of trying to rebuild those relations. Bring families back together, do joint events and joint planning. But it is really hard, because the Indian Act severed those connections. . . . They [elders] were like, "Yes, we need to reestablish those connections with Leq'á:mel." Because what happens there is going to affect us and our community is going to affect them, especially when it comes to climate change.

Indian band divisions, by-products of colonial administration, have discouraged Stó:lō unity, collaboration, and traditional territory stewardship: "We have been placed in Indian reserves, that is all we know, that the Indian reserves are basically ours and we haven't taken the step of saying that we have to look after all of this territory. . . . That is our biggest challenge." (Clarence Pennier, pers. comm.) This, in turn, lowers capacity to respond collectively to trespasses that are common among Stó:lō First Nations.

In addition to Indian band divisions, Stó:lō communities also differ significantly in their political and organizational affiliations (Morrison 2013; Plant 2002). Communication might be lacking among given Stó:lō communities, especially regarding common climate change effects and possibilities for shared adaptation strategies:

> But definitely in regards to climate change, I don't see anything. . . . No conferences or groups coming to discuss climate change. . . . How other Nations farther north to us are being affected by water levels, I don't know, I have no idea. Because there is no communication between us, or a group studying it. (Joseph Dandurand, pers. comm.)

Communication and cooperation among Stó:lō communities is linked to multiple benefits for adaptation. According to research participants, industry and governments have employed divide and conquer techniques with First Nations to assert their interests. Addressing issues through collaborations with Stó:lō and other Indigenous peoples and organizations is described as essential to capitalize on common Indigenous interests and values:

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The Stó:lō people are needing to join up with other Indigenous peoples . . . to stop what is taking place. But there is a mixed will to do this. When you get a large corporation like Kinder Morgan, for example. They pick one First Nation at a time, so some First Nations have entered into agreements. . . . I guess some of us feel like "this is so unstoppable, we might get what we can out of it." (Eddie Gardner, pers. comm.)

Assertion of Aboriginal rights and political advocacy are key to protecting Stó:lō lands and resources that are being threatened by cumulative impacts (Eddie Gardner, pers. comm.; Murray Ned, pers. comm.). As Stó:lō communities share common traditional territory, resources, and values, the Stó:lō have a more impactful claim to their interests and rights when collaborating in unity:

The Stó:lō, if they could speak as one . . . I think they would carry more strength when trying to deal with government. . . . And if you are not working as one, the government really recognizes that, and they will find ways to stir the pot, make sure you are fighting with one another. They keep you occupied that way. And meanwhile, while you are fighting against each other, they are having progress with their agenda. (Murray Ned, pers. comm.)

Additionally, by addressing climate change issues collectively, the Stó:lō hold more potential to determine the object and design of governmental adaptation funding and resources according to their common interests and needs (Stephen McGlenn, pers. comm.). Lack of sufficient financial resources and dependence on government funding currently constrain Stó:lō community adaptation (Eddie Gardner, pers. comm.; Murray Ned, pers. comm.; Shana Roberts, pers. comm.; Stephen McGlenn, pers. comm.; Taylor, pers. comm.). Such dependence is further complicated by incompatibilities between government funding and First Nations' needs. Stephen McGlenn (pers. comm.) expresses ways in which funding is "a huge challenge"—funding is often (i) grant-dependent, (ii) limited in scope of what is eligible, (iii) not sufficiently long-term in length, and (iv) available for (adaptation) planning but not implementation. Government funding should be designed according to First Nations' needs and capacities: "That is the message that we always bring to the government, that funding needs to be predictable and sustainable and for the long term." (Stephen McGlenn, pers. comm.)

Cooperation is especially important for Indian bands that are smaller in population or size, or that are less economically developed (Shana Roberts, pers. comm.). Different Stó:lō bands, particularly those that are in geographical proximity, have the opportunity to devise common adaptation actions and planning so that "one

community that maybe doesn't have the capacity, whether it is financial or human resources, doesn't get left behind." (Shana Roberts, pers. comm.) Cooperation among communities would also expand the geographical and jurisdictional scope of possible adaptations (Shana Roberts, pers. comm.).

Aboriginal Rights and Title recognition

Federal legislation, particularly the Indian Act, established repressive policies to Stó:lō culture, beliefs, social structure, and self-governance, which altered Stó:lō society for assimilation purposes. Major events in colonial history and legislation include the denial of Aboriginal leadership structures and replacement by the Chief and Council system, potlatch prohibition in 1884, ban on Aboriginal legal representation in 1929, and implementation of the residential school system (Carlson 1997b; Tennant 1990). These processes have hindered Stó:lō self-governance and lowered adaptive capacity:

> I guess the main challenge is for us to believe that we can have an impact in changes. Because we have been colonized and we have been under the Indian Act for 150 years or so, decisions are made for us by governments. We are not supposed to be able to make our own decisions. (Clarence Pennier, pers. comm.)

Treaties were never completed in BC, with the exception of the Douglas treaties in Vancouver Island and of a portion of northeastern BC that falls under Treaty 8 (Carlson 1997a). Consequently, the Stó:lō never surrendered their rights to their traditional territory (Carlson 1997a).

A landmark in Aboriginal rights legislation was the enactment of Section 35 of the *Constitution Act, 1982*. Under s. 35(1), Aboriginal and treaty rights are granted constitutional status and protections: "35(1) The existing aboriginal and treaty rights of the aboriginal peoples of Canada are hereby recognized and affirmed." (*Constitution Act, 1982*, s. 35(1)). Whenever governmental decisions or legislation infringe said existing Aboriginal and treaty rights, the Crown has a duty to consult with the infringed Aboriginal group (Isaac and Knox 2003). The duty to consult has been enunciated and developed primarily through case law—it was firstly enunciated by the Supreme Court of Canada in *R. v. Sparrow* in 1990. Subsequent Supreme Court of Canada's decisions in *Delgamuukw v. British Columbia* and *Haida Nation v. British Columbia (Minister of*

Forests) further confirmed and set precedent for the Crown's duty to consult (Isaac and Knox 2003).

In response to evolutions in Aboriginal case law, the province of British Columbia published the *Provincial Policy for Consultation with First Nations* in 2002, which was updated in 2010 (Brady 2014; MARR, n.d.). This policy is operationalized through the Crown's referral process (Morellato 2008). The Province of BC has also entered into Strategic Engagement Agreements (SEAs) with a number of First Nations to establish consultation and accommodation procedures that are agreed upon by all parties (MARR, n.d.). Sixteen Stó:lō First Nations have developed a common Strategic Engagement Agreement with the Province (Stó:lō First Nations and the Province of British Columbia 2016).

However, there are instances in which less than meaningful consultation still presents a challenge for Stó:lō governance over the use and management of their traditional lands and resources (Stephen McGlenn, pers. comm.). Additionally, consideration of climate mitigation and adaptation needs are not being explicitly taken into account in the Crown's decision-making process:

> Resource development in general. . . . A lot of forestry and mining happening without the consent of First Nations. . . . So when a new development comes through, how does climate change inform those decisions the government is making to approve those activities? I don't see a lot of that. (Stephen McGlenn, pers. comm.)

This hinders Stó:lō people's ability to protect culturally significant resources and traditional use areas from current and future impacts. Conversely, recognition of Aboriginal rights and title *should* enable the Stó:lō to meaningfully engage in decision-making regarding the current and future management of their traditional territories:

> The big issues are how do we get the government to accept us as managers of our land. . . . The Crown has a duty to consult and to accommodate our interests. . . . If the Stó:lō are owners of this territory, then we need to be making decisions on how we are going to look after it better than it is being done now. (Clarence Pennier, pers. comm.)

Stó:lō people's stewardship of *S'ólh Téméxw* is paramount to the protection of resources essential to the Stó:lō. Being ancestrally connected to resources, the Stó:lō hold significant potential to guide resource management, sustainable development, and adaptation strategies in ways that mitigate harm to resources that are being threatened

by climate change effects and other sources of cumulative impacts (Clarence Pennier, pers. comm.; Murray Ned, pers. comm.; Stephen McGlenn, pers. comm.):

> What we can do is change how humans practice development along the Fraser River. . . . We have an attachment to the land, culturally and traditionally. And somehow we have to be able to convey those messages and communicate to the public what that means to us, as a Stó:lō, as Sema:th people. (Murray Ned, pers. comm.)

It is important to note that, even though all Stó:lō communities assert their rights to unceded land, the strategies undertaken by different communities to assert said rights vary significantly (Plant 2002). As of October 2018, six Stó:lō First Nations are involved in the BC Treaty Process (SXTA, n.d.). Other communities assert their rights and title in different ways. Traditional land use is an assertion of Aboriginal rights as well as a form of stewardship (Eddie Gardner, pers. comm.). It is through cultural practices in their traditional territory that Stó:lō people connect to the land and resources and exercise Stó:lō stewardship. Political advocacy is an associated tool to assert Aboriginal rights that is empowered by traditional land use:

> There is a lot of people in the communities who . . . are making their own decisions about what needs to be done to prepare for climate change. So they are going out . . . to live off the land, to know where the berries are, to know where the animals are so they can hunt, and fish, and exercise their rights to harvesting in these areas. . . . And if there is an industrial activity that is threatening our fish, or our hunting grounds, or our medicines and food, then . . . they are saying, "Hey, they shouldn't be able to do this because this is what is at stake. We know because we are out there, this is where we are actually using our land." (Eddie Gardner, pers. comm.)

Promotion of Stó:lō culture and connections

Stó:lō culture and connections with nature will assist in adaptation to climate change, as they have assisted during past social and environmental changes (Carrielynn Victor, pers. comm.). Traditional knowledge and the ability to develop connections with other-than-human beings are paramount to finding solutions to support Stó:lō communities as well as the resources that the Stó:lō rely on:

> If we require cultural solutions . . . to honour the spirit of what might be suffering or changing in order to . . . help those populations or species alive, we need the people who can speak that language of understanding more than words. And then relate that message back to the people so that people

listen. We are short on people like that. . . . But in a sense that could be what saves us. (Carrielynn Victor, pers. comm.)

Historical loss of traditional knowledge that could be used to inform adaptation is a significant colonial detriment to adaptive capacity. As Joseph Dandurand (pers. comm.) points out, current Stó:lō elders are "very young in the sense that they didn't really grow up with the old ways," and it is impossible to know whether "a thousand years ago . . . the rivers were low and the fish weren't coming back and the people adapted." The promotion of Stó:lō culture and connections, on the other hand, intends to curb traditional knowledge loss by promoting cultural practice and traditional knowledge transfer.

Being attentive and connecting to the land and resources enables the Stó:lō to perceive changes in nature and to adapt accordingly. Climate change is understood here as an *opportunity* for people to become more adaptable and to follow nature more closely (Ernie Victor, pers. comm.). This is vital because (i) if other-than-human beings are being respected and appreciated, they are more likely to continue to offer themselves to human groups, and (ii) Stó:lō worldview recognizes that contemporary society can only predict and control environmental changes to a certain extent (Ernie Victor, pers. comm.). Consequently, human beings will eventually have to reorganize themselves as the climate transforms the environment:

> Following nature is the gift of Indigenous people to the world. And it is not that we put nature up here, it is equal to us. . . . In Indigenous worldview, if you relate to something on an equal level, it will always be there. If you relate to something like it is less, it stops coming. . . . Adjust yourselves and follow. . . . So, when the water rises because of climate change, we listen. We say, water is rising, so let's move a little higher. . . . At some point, your dikes can't get this high, it will catch up with us. So make the change now and just follow it, adjust, right. . . . I am just using dike as an example. (Ernie Victor, pers. comm.)

Stó:lō connections with other-than-human beings additionally enhance adaptive capacity as they support the connection of community members in a shared territory, tradition, and culture. The Stó:lō are stronger when belonging as a collective and when supported by their culture:

> We belong together. We belong to a territory. . . . We share the songs, we share the ceremonies that we have. That is the way that we connect to one another through our ceremonies and our way of living. . . . It is something

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that other cultures cannot take away from us. The only thing that is going to destroy what we have is a serious diminishment of our relatives in the natural world. (Eddie Gardner, pers. comm.)

Belonging as a collective might be particularly important for the Stó:lō as Salmon People:

Belonging is huge. You see fish go together in schools. One fish finds a hole through a net, they all go through the net. . . . They have this sense that they belong to something that is intangible. . . . The same thing with people. Our culture will help our people as long as we can be practicing our culture, as long as we can be the people. (Ernie Victor, pers. comm.)

3.5. Organizational Roles

This section describes the roles that participants identify as being currently or potentially led by the SRRMC to support Stó:lō community adaptation and to foster Stó:lō adaptive capacity. Links between organizational roles and support of adaptation opportunities are further explored in section 3.6.

The SRRMC supports Stó:lō community adaptive capacity by acting as an information centre and providing outreach to communities (Clarence Pennier, pers. comm.; Patricia "Tia" Halstad[7], pers. comm., July 26, 2017). Leveraging SRRMC's network to provide Stó:lō communities with information from multiple organizations reinforces SRRMC's capacity as a repository of and gateway to relevant information. Outreach to Stó:lō communities ensures that communities and leaders are able to make well-informed adaptation decisions:

To make sure that we get all of the information that comes from different sources. One of the sources now is Fraser Basin Council. . . . Trying to make sure that information is spread out far and wide into our communities. . . . The more information we get in the communities, the better decisions are made. (Clarence Pennier, pers. comm.)

Acting as an information centre includes the provision of educational opportunities in the Centre. Educational opportunities can build capacity for community liaisons in areas where communities need support or are lacking expertise (Tia Halstad, pers. comm.). Regarding future educational opportunities, climate awareness promotion

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[7] From here on referred to as Tia Halstad.

can address gaps in climate literacy and curb climate denial that is still present in communities (Maretta Beger, pers. comm.; Tia Halstad, pers. comm.). According to Shana Roberts (pers. comm.), it is important to "ensure that people are aware of the challenges and the opportunities that come with climate change."

Provision of cultural information (e.g., traditional uses) can be used to assert Stó:lō Aboriginal rights to resources and use areas that are being threatened by cumulative impacts. This is one of the ways in which the Centre is promoting and perpetuating Stó:lō culture:

> I think integrating our oral traditions, our practices, the Centre is very much at the forefront of promoting that. . . . Our leadership also uses this information to try and curb the colonial powers that are always threatening to compromise our ability to live our way of life. (Eddie Gardner, pers. comm.)

Additionally, the provision and dissemination of cultural information connects people to their ancestral lands and resources, and consequently acts as a driver of stewardship, self-governance, and adaptive capacity: "As the people become more aware of some of the traditional uses of our territory, then we can better step forward and look at the changes that have gone, and learn to assert our evolution to make use of the territory." (Eddie Gardner, pers. comm.)

It is also mentioned that the SRRMC could expand its cultural promotion activities to act as a point of connection to traditional practices for community members that do not have access to such practices through their personal networks. As Carrielynn Victor (pers. comm.) notes, "When and where is that stuff [spiritual work] going to happen for those of us . . . who aren't connected through their own aunts and uncles to the culture? Who facilitates that aspect of the culture to those people? Currently nobody."

The SRRMC fosters community adaptive capacity by conducting research that meets community information needs (Eddie Gardner, pers. comm.). In this way, the Centre facilitates much-needed resource management and stewardship projects. SRRMC's research capacity is another valuable tool in supporting Stó:lō Aboriginal rights and in protecting the continuation of Fraser River salmon populations (Eddie Gardner, pers. comm.)

Sonny McHalsie (pers. comm.) suggests future research could include "an inventory of those [berry picking] places so that more people could rely on those berries and return back to picking those berries. . . . Picking herbs too . . . an inventory on those different plants, what has the effect been on those plants?" Identification of traditional use areas and assessment of traditional plants health and availability would be important not only to understand climate change effects to these resources, but also to facilitate community members' connections with them (Sonny McHalsie, pers. comm.).

SRRMC's technical capacity is described as a particularly valuable asset for communities (Murray Ned, pers. comm.; Stephen McGlenn, pers. comm.). These services are perceived as "critical" to advance projects on a technical level, given that technical capacity is often insufficient within communities (Murray Ned, pers. comm.). Communities are also frequently overstretched in their own capacity: "First Nations are so overwhelmed. . . . Having someone like the SRRMC that can help understand the technical stuff, that is a huge help for us in general." (Stephen McGlenn, pers. comm.)

Being a Stó:lō organization, the Centre combines technical capacity with Stó:lō values, protocols, and community knowledge. The SRRMC aims to fill capacity gaps in communities, but unlike consultancies that do not share Indigenous mandates, it does so from a community perspective (Shana Roberts, pers. comm.). Having technical capacity provided by an organization that develops relationships with communities and that serves as an ongoing "repository of knowledge" is, in this sense, an advantage to community capacity when engaging with the SRRMC (Stephen McGlenn, pers. comm.).

Particularly important to the identified opportunity of promoting Stó:lō intercommunity cooperation is SRRMC's role as a network facilitator. The SRRMC is well positioned to foster communication and cooperation among Stó:lō communities and among Stó:lō organizations (Murray Ned, pers. comm.). This is especially needed to capitalize on common objectives and to prevent redundancy in projects:

> So, you might have the LFFA [Lower Fraser Fisheries Alliance] dealing with fisheries, you might have the SRRMC dealing with land-based situations. . . . These kinds of organizations have to work with one, ensure there is no redundancy. . . . We need to ensure that we are not doing the same work. (Murray Ned, pers. comm.)

The SRRMC functions as a bridge among Stó:lō communities, given that it works with and for all Stó:lō communities, independently of political affiliations. The Centre can facilitate that independent communities add to collective Stó:lō (climate) conversations: "We always need to be mindful of those organizations reaching out to the independent bands. . . . There should be still an open door at least reaching out to one another to stay in contact and communicate." (Murray Ned, pers. comm.)

The SRRMC holds a unique potential to identify drivers of cumulative effects on Stó:lō heritage through the accumulation of information on Stó:lō Connect. Referrals review allows the SRRMC to have access to a wide range of development proposals to *S'ólh Téméxw*, and to identify and assess potential impacts to Stó:lō territory and heritage (David Schaepe, pers. comm.). The development of a framework to assess cumulative effects and to integrate other layers of information into Stó:lō Connect is an important topic to be considered in future work (David Schaepe, pers. comm.).

Said cumulative effects would be assessed in relation to current or past baselines, in other words, "where we are today as a foundation for determining the relative scope of potential impacts." (David Schaepe, pers. comm.) Thus, developing current and historical baselines could be a first step in (i) understanding what has already been affected by development, climate change effects, and other sources of cumulative impacts, and (ii) monitoring future changes:

> What role does global climate change have as another factor in this? Number one, as a factor of our baseline today. We need to go farther back in time to look at various points of what is going on in the environment. If we look at it today, it is going to be factoring some elements of global climate change, which isn't necessarily what we want to do in establishing a baseline. But we do want to track and measure things that are going on. (David Schaepe, pers. comm.)

Another possibility is for the Centre to further disseminate available information and facilitate cumulative effects studies conduction by external agencies:

> The departments, the industries, and the other governments all do their own studies and nobody talks to each other. . . . And because this Centre has the capacity to see all of what is happening . . . we are more likely to see a cumulative effect coming then a single industry, partner or a single branch of the government. . . . We need to make this information available. (Carrielynn Victor, pers. comm.)

Lastly, adaptation planning *with* and *for* Stó:lō communities—planning based on communities' values and interests—is an initiative that was starting to be pursued by the SRRMC at the time of data collection (Taylor, pers. comm.). The SRRMC has the needed capacity to access adaptation funding and to support communities in adaptation planning. Through the Centre's networks and diverse expertise, it can also support communities in preparing for the following step of implementation and its funding, which is more difficult for communities to navigate given lack of government funding for implementation (Shana Roberts, pers. comm.; Taylor, pers. comm.).

3.6. Recommendations

This section summarizes the results described in this chapter as the bases for recommendations for the betterment of Stó:lō communities in a changing climate and, more specifically, for action by SRRMC to support Stó:lō communities in this regard. Recommendations to the collective Stó:lō community should be taken as partial suggestions, given that research methods were developed from an organizational viewpoint, did not delve into specificities of Stó:lō communities, and therefore cannot represent the complexity and diversity of Stó:lō First Nations.

As a natural progression from the presentation of participants' responses, this final section allows for more researcher subjectivity, interpretations, and suggestions as a complement to the information derived from the interviews. I structure the recommendations based on (i) reported climate effects and associated adaptation actions (or lack thereof), and (ii) adaptation opportunities and their interconnections to organizational roles. I also insert a final section with additional considerations that are specific to the SRRMC.

Reported climate effects and adaptation actions

Decline in Fraser River salmonid populations is the most relevant impact reported in this study. Along with lower Fraser River water levels, impacts to salmonids are restricting access to fishing, to connecting with salmon, and to consuming salmon as a traditional food source. As described in section 3.3, it is clear that Stó:lō communities and organizations are engaged in Fraser River salmon integrated management and climate change adaptation, as well as in political advocacy for wild salmon protection.

Best practices for Fraser River salmon management are beyond the scope of this study; therefore, I do not present any recommendations specific to mitigating harm to salmonids. However, I deem important to stress the unique relevance of Fraser River salmon to the Stó:lō. This study indicates that mitigating harm to Fraser River salmon may be the most significant action that governments can take to support Stó:lō climate adaptation.

Impacts to other traditional resources besides Fraser River salmon also exert effects on Stó:lō communities, but it is unclear (i) which of these impacts are in fact related to climatic changes and are likely to become increasingly prominent as climate change effects ensue, and (ii) whether Stó:lō communities are addressing these impacts in any way, other than by adapting their cultural practices to adjust to environmental shifts, and by promoting Stó:lō stewardship of *S'ólh Téméxw*.

Given this study's indication that access to traditional resources is vital to Stó:lō health, food security, cultural practices, and spiritual connections, I conclude that Stó:lō communities are likely to benefit from more diverse adaptation actions regarding traditional resources. These might include:

    i.   Research and monitoring to assess the (i) current and ongoing conditions of Stó:lō traditional resources, and (ii) drivers of change in resource availability, distribution, and seasonal patterns.

    ii.   Intercommunity coordinated actions to manage common Stó:lō resources for their long-term sustainability facing cumulative impacts.

Resource management is likely only feasible for species that can be managed within reservation boundaries (e.g., traditional plants greenhouses). Jurisdictional limitations restricts adaptation actions for species that cannot be managed within these boundaries (e.g., western redcedar). For such traditional resources, Stó:lō communities may need to collectively assess which resources should be prioritized regarding efforts in political advocacy and Aboriginal rights assertion.

Regarding the above recommendations, the SRRMC has the potential to support communities in various ways, including through facilitation of intercommunity dialogues to collectively identify which traditional resources should be strategically invested in for

harm mitigation and adaptation purposes. The SRRMC also houses technical capacity to support communities with traditional resources research, monitoring, and adaptation needs. Such support could include traditional plant and medicine inventories, resource, resource change, and resource use mapping, applications of traditional stewardship for adaptation purposes, among others.

This study also indicates that traditional foods are especially relevant to Stó:lō health and well-being. Diversification of food sources through increase in store-bought foods seems to be the most prevalent adaptation action specific to traditional foods scarcity. As addressed in section 3.2, this exerts adverse consequences for Stó:lō health and financial security. An additional identified adaptation action is the sharing of traditional foods with extended family, which can act as a food security network. I would thus recommend that Stó:lō communities and organizations plan for future food security and adverse effects of traditional foods scarcity. The SRRMC holds capacity to further mainstream food security as a distinct component of its current activities, such as social and political network mobilizations, climate change adaptation planning, and policy development.

Table 3.7 summarizes conclusions and proposed recommendations for the collective Stó:lō community and for the SRRMC, stemming from the analysis of reported effects on Stó:lō communities and identified adaptation actions.

Table 3-7.   Conclusions and recommendations

Conclusions and recommendations	
Collective Stó:lō community	• Stó:lō communities are likely to benefit from more diverse traditional resource adaptation actions. • Stó:lō communities are likely to benefit from food security and traditional foods scarcity planning.
SRRMC	• The SRRMC is well positioned to facilitate strategic intercommunity dialogues for climate adaptation. • SRRMC's technical and research capacity can be valuable in understanding current conditions of and threats to traditional resources. • The SRRMC holds the needed capacity to support communities in diversifying their adaptation portfolios.

Adaptation opportunities

I proceed to expand on each adaptation opportunity and on how identified organizational roles can promote them.

Cooperation within Stó:lō community

Cooperation within the Stó:lō community is described as an important element for climate change adaptation. Particularly important are the identification of common Stó:lō adaptation interests and needs (Shana Roberts, pers. comm.; Stephen McGlenn, pers. comm.), and the refocus of stewardship efforts beyond reservation boundaries and into the full extension of traditional territory (Clarence Pennier, pers. comm.).

The SRRMC is positioned and equipped to act as a channel of communication between affiliated and independent Stó:lō First Nations (Murray Ned, pers. comm.). Thus, the SRRMC can promote this adaptation opportunity through fostering communication among Stó:lō First Nations—and among Stó:lō organizations—in order to support the development of shared adaptive strategies that avoid (i) fragmentation in financial and capacity resources for adaptation and (ii) redundancy in adaptation efforts (Joseph Dandurand, pers. comm.; Murray Ned, pers. comm.).

As an organization that has an extensive Indigenous and non-Indigenous network (Tia Halstad, pers. comm.), SRRMC's potential for project cooperation and integration beyond the Stó:lō community also holds particular potential for Stó:lō adaptive capacity. Participants express added difficulties in engaging with external agencies due to a lack of consideration of Indigenous values and protocols. One participant indicates that lack of an "Indigenous lens" to adaptation dialogues with external agencies acts as a constraint for adaptation (Taylor, pers. comm.). Therefore, SRRMC's network and cultural education services can also support Stó:lō climate adaptation through efforts to educate non-Indigenous agencies and stakeholders in Stó:lō worldview, values, and protocols, in order to develop more effective adaptation dialogues and cooperation.

Aboriginal Rights and Title recognition

Assertion of Aboriginal rights and title is an integral aspect of SRRMC's mission and trajectory (David Schaepe, pers. comm.; Tia Halstad, pers. comm.). Recognition of Aboriginal rights and title is essential for the Stó:lō to effectively exercise stewardship and protect the lands, resources, and waterways that are being threatened by change in climate (Clarence Pennier, pers. comm.; Eddie Gardner, pers. comm.). However, the link between Aboriginal rights and the threat of global climate change to said rights has not

been made explicit throughout SRRMC's efforts. This could be advanced, for example, through cumulative effects studies, or through mainstreaming climate change considerations into policy development and referrals review. This is further explored below and in the next section.

Given this study's results, I conclude that consultation processes should incorporate a climate lens, especially when proposed development infringes on traditional resources that are essential for Stó:lō food security and cultural identity. In a changing climate, it is important to consider whether development proposals will lead to decreased resource resilience in adapting to future climatic change, or to maximization of current and projected climate effects—i.e., this would be the case of any proposals that may further decrease Fraser River salmon resilience or warm Fraser River temperatures, respectively.

Consideration of climate change effects in consultation processes may include reflection upon how proposal decisions might, for a given time period, (i) exacerbate projected climate change effects, (ii) decrease resilience to climate change effects, and (iii) change their societal value given future change in climate—i.e., if a given area is projected to become less suitable for a proposed development given future change in climate, this might in turn lower the development's future societal value. These considerations could be incorporated into government-to-government policy, such as Strategic Engagement Agreements (SEAs). Consideration of climate change effects, or of cumulative effects, could be included as an additional "criteria for changes to engagement level" in SEAs (Stó:lō First Nations and the Province of British Columbia 2016, 36).

Promotion of Stó:lō culture and connections

Participants express that promotion of Stó:lō culture and connections to traditional territory and resources is paramount to Stó:lō well-being, cultural identity, and belonging as a collective (Carrielynn Victor, pers. comm.; Eddie Gardner, pers. comm.; Ernie Victor, pers. comm.). The SRRMC is already heavily involved in the promotion and continuation of Stó:lō culture. As described in section 3.5, the SRRMC supports this adaptation opportunity especially through its Stó:lō cultural perpetuation, technical capacity, and research services. Moreover, through the incorporation of Stó:lō cultural values and protocols in its mandate (David Schaepe, pers. comm.), the SRRMC

indirectly promotes Stó:lō culture in all its activities. In this way, the Centre also serves as a model for other Indigenous organizations to promote cultural perpetuation at the core of their mission and vision.

Additional considerations specific to the SRRMC

This case study indicates that the SRRMC is already involved in supporting Stó:lō adaptive capacity through the informational, research, technical expertise, and cultural perpetuation services it provides. SRRMC's expanding capacity for climate change adaptation planning, cumulative effects studies, and policy development underscores key areas for future development in supporting Stó:lō communities as they adapt to a changing climate. I proceed to draw suggestions on how to expand the organization's capacity.

Specifically regarding proposed development of cumulative effects studies (explored in section 3.5), these could be explored through establishment of baselines to measure past and ongoing changes (David Schaepe, pers. comm.). Research potential derived from developing a baseline and measuring ongoing climate effects to specific resources or traditional use areas could act as a *justification* for the protection of certain areas from additional impacts.

Alternatively, cumulative effects could be explored as constructed future scenarios for referrals review. Scenarios could depict projected cumulative effects upon a given traditional resource or traditional use area—including climate change effects— for different time periods into the future. It might be useful to contrast a "control" climate change effects scenario to a climate change effects plus development effects scenario for communities and governments to better visualize the magnitude of impacts and threats to specific resources or use areas. In this case, cumulative effects simulations would be less focused on knowledge development and primarily employed as a visualization tool.

The exact nature of additional layers of information to be integrated in Stó:lō Connect is uncertain and would depend on what is the chosen focus of a cumulative effects study pilot. I would suggest that additional layers might include information derived from available oral history and traditional knowledge, local observations,

available scientific data, and/or climate projections—however, I am not certain which of these layers would be feasible. It might be more feasible to develop a pilot baseline or cumulative effects study for one specific traditional resource that is the focus of abundant data, or for one specific traditional use area.

Regarding policy development, mapping of traditional resource use could be further added to the *S'ólh Téméxw Use Plan*, the *S'ólh Téméxw Use Plan Policy* (SRRMC 2014) and, subsequently, to Stó:lō Connect. The *S'ólh Téméxw Use Plan Version 11* includes information on traditional resource use and habitat in the Canyon Heritage Area and Subalpine Park zones. Additional zones could delineate traditional use zones and/or sensitive habitat for traditional resources of particular importance— e.g., Fraser River salmon. Having this information integrated into Stó:lō Connect would facilitate protection of resources that are facing cumulative impacts. These zones could also be coded according to a given resource's degree of vulnerability and importance. For example, sensitive habitat for resources that are expected to be affected by change in climate could receive a special colour code on the map representing higher risk.

Information to develop additional use plan zones or to employ in combination with Stó:lō Connect may be derived from existing traditional use studies and mapping efforts, such as LFFA's Lower Fraser Aboriginal Knowledge maps and mapping currently being developed for the Lower Fraser Climate Adapt project (LFFA, n.d.). However, literature suggests there may be a need to keep local observations and traditional knowledge of resource locations confidential to communities or family groups, depending on circumstances (Williams and Hardison 2013).

Finally, if the SRRMC decides to develop climate change adaptation policy for Stó:lō communities (e.g., best practices for Stó:lō community adaptation), the organization could integrate recommendations and conclusions from this case study, as well as from their own experience in climate change adaptation planning. Given participant expression of lack of sufficient financial resources for adaptation, communities may particularly benefit from SRRMC's (i) direct support in securing of funding sources and in planning for adaptation implementation, and (ii) policy development that guides Stó:lō communities in securing adaptation planning and implementation funding.

Chapter 4.

Results and Recommendations: FAHF

I divide this chapter in six sections. I begin by presenting the results from the domains that comprised the content analysis: observed climatic and environmental changes, reported cumulative effects on the tribal community, identified adaptation actions, adaptation opportunities, and organizational roles. The final section summarizes lessons learned from the case study results and drafts recommendations for organizational support of community adaptation. The relationships between domains and research objectives are described in section 1.5.

I strive to describe the content analysis based solely on participants' semi-structured interview responses. I allow for more researcher subjectivity in section 4.6, where I further analyze the links between the different domains and what conclusions and recommendations can be derived therefrom.

4.1. Observed Climatic and Environmental Changes

This domain refers to changes that participants have observed in the climate and natural environment of their traditional territories and which they deem possibly caused by global climate change. I refer to these changes as "impacts," as they are directly connected to the effects on communities described in section 4.2.

I categorize these impacts into four categories: aridification, traditional resources, increased risks, and climate and seasonal patterns. Participants' observations indicate that many of these impacts are interconnected; however, they are here divided into four categories for visualization purposes. Due to such interconnections, many relevant interview excerpts refer to multiple impacts. Thus, I present interview excerpts that best describe not only the impacts but also the interconnections among them, instead of organizing excerpts by individual impact.

The impacts are displayed on tables 10, 11, 12, and 13 according to the number of participants who referred to each impact. However, this does not constitute a

quantitative analysis, given that data collection methods were qualitative and participants were not systematically questioned about each impact.

Aridification

Table 4.1 depicts impacts related to increase in local climate aridification, including impacts to the Tribe's rivers and water supply. Participants consistently report decline in snowfall in the reservation and the multiple ways it affects the Tribe and its members. Participants relate decline in snowfall to increase in temperatures, as well as to observed warmer and shorter winters:

> It seems like the rainfall and the snowfall have become less and the temperatures have gone up a lot. And the winters, it seems like they were longer. I remember years ago, the ski resort would be open until May. And now we are lucky if we get a snowfall in December and we are open until February. (Shannon Tsosie, pers. comm., May 24, 2017)

The amount of snowfall has decreased significantly, especially when compared to elders' memories of past winters: "[Nowadays] we are lucky to get a foot. A foot is a big snow. And when the elders talk about big snow, it was six feet snow bank. Two or three feet of snow on top of Mount Baldy in June. That is why it was called White Mountain." (Cline Griggs, pers. comm.)

Decline in snowfall has led to changes in runoff and in the amount of water available in the reservation: "We get snow, but it is melting in one day and back in the days, my goodness, it took forever and ever to melt. We had a lot of water." (Rowena Cooya, pers. comm., May 31, 2017)

Rochelle Lacapa (pers. comm., May 26, 2017) shares her personal memories of snowfall growing up in the reservation:

> Christmases were always with my grandparents at McNary, and I remember almost every year growing up that you had to drive through walls of snow in order to get to their house. Some Christmases, you know, when we got there, there might be a little snow on the ground, and by the time we were leaving, four, five hours later, we were shoveling out cars from the snow. McNary is lucky to get snow now.

Shannon Tsosie (pers. comm.) contrasts her childhood memories of snow activities to contemporary childhood experiences:

When I was younger . . . we could play in the snow, we could slide in the snow for maybe a week at a time. But now . . . it seems like it is just a dusting of snow, it is never cold enough for it to actually stay. My nieces and nephews, they have never had the opportunity to sled here. Behind my dad's house, there was a hill that all the kids in the community would go to and play during snow days. But now there is not even enough to sled down.

Cline Griggs (pers. comm.) explain how different types of rain that are distinguished in Apache language are decreasing in frequency: "A quick rain during the summer . . . the one that soaks the ground. There is not many of them during the summer. . . . The ones that would fall and soak the land, the plants and everything. Those are getting rare too."

Decline in snowfall and changes in seasonal patterns are leading to hydrological changes to the Tribe's rivers. The most significant impact among these changes is the reduction in river water levels, especially during the summer:

Changes in even the flow regimes, we have the earlier snowpack. . . . Before we would have, about April, May, our high flows coming through. And now we are seeing them earlier than that, when we see our snowpack melting in February, March. . . . So, by the time June comes around, we have a pretty low flow. . . . We are scrambling with low flows and warmer temperatures. (Cheryl Pailzote, pers. comm.)

Cheryl Pailzote also indicates that climatic changes are lowering the Tribe's water quality: "We are also seeing algae growth in our facility. . . . That is more of a nuisance problem than it is a public health concern, but people are not going to drink their water."

Table 4-1.   Aridification

Impact	Number of references
Lower snowfall	9
Drier weather	7
Lower river water levels	5
Lower rainfall	5
Lower water quality	2

Traditional resources

Table 4.2 depicts impacts related to resources that are traditional to the White Mountain Apache. Participants report a decrease in availability of certain traditional

plants and medicines within the reservation (Ali, pers. comm.; Leeann Lacapa, pers. comm., May 31, 2017; Rowena Cooya, pers. comm.):

> The resources, the berries, some of the plants, not having that vegetation anymore. . . . There are limited resources for what we need for ceremonies, there are certain things that we do certain times of the year. That the resources are scarce now for the things, sometimes we have to go outside to other peoples to be able to find what we need. . . . Some of the nuts and the berries . . . you could find that in your backyard, we don't find those anymore. (Leeann Lacapa, pers. comm.)

Elk and deer populations relocate and become less available in the reservation as the ecosystems are affected by wildfires and reduced soil moisture (Rowena Cooya, pers. comm.). Gwendena Lee-Gatewood (pers. comm., May 24, 2017) explains the connection between decline in snowfall and decreased elk and deer health and availability:

> It used to snow a lot . . . it would snow two feet or above throughout the winter time. . . . And that used to help our elk population and deer population because when there is a lot of moisture, then they feed off of the grass. . . . And now because it does not snow that much anymore, their growth is stunted . . . you can tell that they are not fully up to par with what they should look. . . . We don't have as big of an elk herd as we once did. . . . The elk herd is dropping down and our deer herd is already at a really low point.

Table 4-2.   Traditional resources

Impact	Number of references
Decreased availability of traditional plants and medicines	5
Decline in elk and deer populations	3
Less healthy elk and deer	1

Increased risks

Table 4.3 depicts other impacts that may pose increased risks to the tribal community, such as extreme weather events. Wildfire frequency and severity in the reservation has increased in the last ten to fifteen years (Krista Beazley, pers. comm. June 2, 2017). Increase in wildfires is consistently reported by participants and deemed "one of the major, huge contributions of climate change." (Krista Beazley, pers. comm.) Wildfire effects are manifold, and are discussed in detail in section 4.2. Krista Beazley (pers. comm.) notices the drastic change in wildfire frequency since her childhood:

"When we were growing up, I never heard of forest fires. I think since the last ten years it pretty much kind of came out. Every summer we have to deal with forest fires."

Gwendena Lee-Gatewood (pers. comm.) explains the connection between local climate aridification and increase in wildfire frequency and severity:

> Because we have had no snowfall and limited rain, and that then affects the fire weather activity here, because it is more dry. And our trees have a moisture content level that we measure. . . . And the past three years, that reading has dropped to where the inside of the trees are like as dry as a cracker, just dry. So when you have . . . a fire, it is just like lighting a match and everything is just burning up.

Wildfires are also correlated to increase in flooding in the reservation: "And then once the rains come after things get burnt, because the soil, the roots have been affected. . . . If you get rain now, you now have a flood problem, because there is nothing holding the water and the people then get affected with flooding." (Gwendena Lee-Gatewood, pers. comm.)

Increase in wildfire frequency indicates that the whole reservation is increasingly likely to experience wildfire events. Participants are concerned about the possibility of a future wildfire in the Wilderness area, which has not been subjected to forest management and is especially vulnerable to harmful wildfire effects (Angel, pers. comm., June 1, 2017; Cheryl Pailzote, pers. comm.; Gwendena Lee-Gatewood, pers. comm.). The significance of the tribal Wilderness area is explored in section 4.2.

Rochelle Lacapa (pers. comm.) describes increase in bark beetle and cicada infestations, and explains the connections to reduced soil moisture and warmer winter temperatures:

> We are seeing huge numbers of trees . . . that have been infested with bark beetle, which then kills trees. . . . As the bark beetle population moves out, a new cicada moves in and kills a different type of tree. . . . If there was enough moisture, from what I understand, those types of insects don't move in and they are not as pervasive. Also, with the cicada, the thing that controls that population is a harder freeze in the winter and because our temperatures are not dropping low enough to kill the cicada, they survive and they multiply in the spring and destroy more trees.

Table 4-3.   Increased risks

Impact	Number of references
More frequent wildfires	8
More risk of wildfire in Mt. Baldy Wilderness	3
More frequent floods	2
More beetle infestations	2
More cicadas	1

Climate and seasonal patterns

Table 4.4 depicts additional observed changes in local climate and seasonal patterns. Alexis (pers. comm., May 30, 2017) describes changes in seasonal patterns, particularly the timing of rainfall and snowfall, which result in an overall less predictable weather:

> Usually we don't have this much rain [in May], we usually don't have rain until July. But I think that in the last few years the rain has started to come in June. . . . The seasons don't seem to know when they are supposed to come. Like it snowed recently here . . . that was May. The weather is very changing now.

Cline Griggs (pers. comm.) reports unpredictable temperature and snowfall. These shifts are recent and older generations find them unfamiliar and puzzling: "Some time in December . . . when you are expecting snow, it is t-shirt weather, and you wonder what is going on. During the summer time, these cold spells that come in, you hear the old ones say, 'This never happened before. What is going on?' "

Warmer year-round temperatures are causing widespread changes in the local climate and natural environment. Snowfall has decreased and become less predictable, with consequent drier local weather: "How the weather is, it is a little hotter, like a few degrees of what it was before. And the overall change is affecting everything and I can see it, and because of that you just wonder when we will ever get snow again, and we don't know that." (Gwendena Lee-Gatewood, pers. comm.)

Table 4-4.   Climate and seasonal patterns

Impact	Number of references
Changes in seasonal patterns	6
Less predictable weather	4
Warmer temperatures (year-round)	5
Warmer winters	2
Shorter winters	2

4.2. Reported Cumulative Effects on the Tribal Community

Reported cumulative effects on the tribal community comprise the effects that participants report as deriving from the climatic and environmental changes described in section 4.1. To a lesser extent, some participants also mention ways in which the tribal community may be affected in the future, given current climatic trends and knowledge of projected climate change effects.

I display these effects according to four categories: effects specific to wildfires, impacts to traditional practices, threats to long-term water supply, and other impacts to economic development. The two latter categories are merged into "other impacts" in table 4.5. All effects listed in the first category are *exclusively* driven by wildfires or by threats of wildfires. This categorization highlights the central role that wildfires and their increasing frequency and intensity occupy when discussing climate effects in the White Mountain Apache Tribe.

During the analysis, it became clear that certain effects are impacting the tribal community in multiple ways. I address this by further categorizing the themes that surface in participants' discourses into eight affected dimensions: safety, water security, food security, financial security, health, cultural identity, cultural practices, and spiritual connections. As shown in table 4.5, the effects are in this way cross-referenced with these eight dimensions. One could argue that all of these dimensions are interrelated to some degree; however, I deem that this categorization further clarifies the specific ways in which the tribal community and its members are being affected by change in climate, and by environmental change more broadly.

The reported effects are linked to these dimensions based on information disclosed by research participants. For example, even though any impact to food security would potentially have an adverse financial effect on households, this link is only categorized where explicitly mentioned by participants. Neither the listed effects nor the identified dimensions intend to be exhaustive. Not all of the identified impacts in section 4.1. were fully investigated in their consequences to the tribal community.

Table 4-5.   Reported effects on the tribal community and affected dimensions

Effects specific to wildfires	Impacts to traditional practices	Other impacts
Evacuations Safety Financial Security Health	**Less productive and more costly farming** Food Security Financial Security	**Threats to long-term water supply** Water Security
Reduced uses of forests Financial Security Health Cultural Practices	**Less available and healthy cattle** Food Security	**Other impacts to economic development** Financial Security
Increased risks to Wilderness area Health Water Security Cultural Practices Spiritual Connections	**Less access to fishing** Food Security	
	Wildlife less available for subsistence hunting Food Security Financial Security	
	Resources less available for traditional uses Health Cultural Identity Cultural Practices Spiritual Connections	

Effects specific to wildfires

The frequency and severity of forest wildfires have been increasing throughout the western United States since the 1970s (Fleishman et al. 2013). Increase in forest wildfires is caused by factors such as increased drought, earlier spring, and higher temperatures and lower soil moisture during fire seasons (Fleishman et al. 2013). The state of Arizona experienced an average of eleven more large wildfires (larger than

1,000 acres) per year during the period 2010–2015 when compared to large wildfire patterns during the 1970s (Kenward, Sanford, and Bronzan 2016). The White Mountain Apache Tribe was especially affected by the Rodeo-Chediski fire in 2002, which burned more than 200,000 acres of the reservation (Keller 2005).

Wildfire severity in the western United States is expected to increase with a changing climate (Cayan et al. 2013). Cayan et al. (2013) reference a 2011 study by the National Research Council, which projects a 380% increase in area burned in the mountains of Arizona and New Mexico with a 1 degree Celsius increase in temperature.

Evacuations

Wildfires are "one of the most dangerous" circumstances that tribal members have to cope with in the reservation (Alexis, pers. comm.). Communities are evacuated if wildfires are approaching them (Gwendena Lee-Gatewood, pers. comm.). Evacuations are not uncommon, and tribal members are annually instructed to be prepared to evacuate their homes if and whenever necessary (Alexis, pers. comm.). Alexis (pers. comm.) shares memories of evacuation: "We had the Rodeo-Chediski fire, and that was pretty scary. . . . That year we were evacuated. . . . We had to leave everything that we had and just pack the things that were important to us and leave."

Participants perceive wildfires to be dangerous as they compromise tribal members' personal safety, productivity, and financial security: "When you get a wildland fire . . . the people, if they use that area, if that is their land . . . they can't use it anymore and their safety is in compromise." (Gwendena Lee-Gatewood, pers. comm.)

Evacuation is not only dangerous and traumatic, but also inconvenient and upsetting as a forced relocation to a place that does not feel like home. Tribal members feel especially uncomfortable when they need to be evacuated outside of the reservation:

> Sometimes they will evacuate them to another area of the reservation. They tried to do that more so because they are more comfortable in their own surroundings. But if we were to evacuate them off the reservation, like to a Caucasian community, they are a little hesitant. (Gwendena Lee-Gatewood, pers. comm.)

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Reduced uses of forests

The Tribe has been historically dependent on natural resources for its economic development (Angel, pers. comm.). Sawmill closures following the Rodeo-Chediski fire resulted in a significant financial impact to the Tribe: "We had a major fire . . . it affected the timber industry that we had, where we sold timber finished product." (Gwendena Lee-Gatewood, pers. comm.) The value of timber lost during this fire was put at over 200 million dollars by one expert (Keller 2005). After the closure of the Tribe's two sawmills, unemployment rates further plummeted from a previous 60 per cent unemployment rate (Keller 2005).

Fire restrictions and threats of wildfires decrease the number of incoming tourists to the Tribe, which in turn has financial effects on the tribal community (Cheryl Pailzote, pers. comm.): "The forest service, they have the fire restrictions. And the Tribe usually tries to hold off until after memorial weekend, because they need that money. They need the campers coming in. . . . We have seen our recreation drop because of these forest fires." (Cheryl Pailzote, pers. comm.). The Tribe's recreational services are being negatively affected for tourists and tribal members alike (Krista Beazley, pers. comm.).

Increase in wildfires has similarly decreased tribal members' sense of safety when using the forests for recreation, and for cultural practices and events. The recurrent threat of wildfires has changed tribal members' patterns of interaction with their forests, reducing forest services during the past ten to fifteen years (Krista Beazley, pers. comm.):

> Everybody wanting to go camping, being out in the woods, it is huge this time of the year. And I know for the past years it has been scary, people don't want to go camping. . . . Last year there was a youth program that we were supposed to do. They weren't able to do their event. (Krista Beazley, pers. comm.)

Increased risks to Wilderness area

Mount Baldy is a sacred Apache site and the habitat for many traditional Apache resources (Angel, pers. comm.; Rochelle Lacapa, pers. comm.). As a sacred site, its protection is important for tribal members' spiritual connections and well-being. Mount Baldy (11,421 feet) is located within a tribal Wilderness area, which has been designated as a pristine and protected area since the 1960s (USDA, n.d.). The tribal Wilderness

area borders the Apache-Sitgreaves National Forests and prohibits activities that are perceived as a disturbance to this pristine state (USDA, n.d.).

Participants share their concern that a wildfire might significantly harm this area of the Tribe (Angel, pers. comm.; Cheryl Pailzote, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Rochelle Lacapa, pers. comm.). Cheryl Pailzote (pers. comm.) explains how the Mount Baldy area is especially vulnerable to wildfires due to lack of forest management: "They didn't want to do treatment on that site. But we have seen impacts, beetle infestation, no types of management in the areas. Really, if anything were to happen in that site, because there is so much material, it would burn heavily."

If a wildfire were to occur in this area, it would have negative effects on tribal members' ability to conduct cultural practices, given that traditional resources are gathered at this site:

> In ceremony or in medicinal purposes there are certain plants and herbs and pollen that you go out and you collect and use for a certain reason. A lot of those herbs and plants are collected in the Mount Baldy area, which is a sacred site. It is our sacred mountain for the Tribe. (Rochelle Lacapa, pers. comm.)

A distinct reason for concern is the impact that a wildfire in this area would have on the Tribe's water supply. This is described as "a huge concern" (Cheryl Pailzote, pers. comm.) and as "the worst thing that can happen." (Angel, pers. comm.) According to Angel (pers. comm.), "If the whole mountain burns, then there will be no water here. It will mess up all the springs, all the ashes. We sometimes complain about no water down here, it will be worse once that mountain blows up."

Impacts to traditional practices

Prior to the establishment of the Fort Apache Indian Reservation in 1870, the Western Apache relied on a combination of subsistence agriculture, hunting, traditional plants gathering, and cattle and other livestock raiding for their sustenance and economy (Basso 1970, 3). Subsistence practices involving agriculture, hunting, cattle raising, plants gathering, and fishing are still significant for tribal members' food security (Gwendena Lee-Gatewood, pers. comm.; Leeann Lacapa, pers. comm.; Rowena Cooya, pers. comm.). Traditional practices also include resource use for medicinal purposes and

ceremonies, most notably the Sunrise Dance Ceremony (also termed Girls' Puberty Ceremony) (Basso 1970, 53). This section describes how traditional practices are being affected by change in climate.

Less productive and more costly farming

Reduced rainfall, reduced snowfall and runoff, and increase in floods are affecting farming activities. Floods wash out roads that lead to rural properties and hinder access to the properties (Avery, pers. comm., June 1, 2017). Reduced precipitation and soil moisture lower farming productivity and feasibility, especially for certain crops:

> It has impacted how we plant, what we plant. . . . It depends on how good of a winter you have had, and that determines kind of what you are going to be able to plant. . . . When you don't get the rains in the spring and your corn doesn't grow, then you have to plan for that too. (Leeann Lacapa, pers. comm.)

Changes in seasonal patterns are making the correct timing of farming less predictable: "Winter starts late and hangs around later into the spring. . . . I have heard a lot of farmers upset, I am not sure if the almanac can actually predict winter planting correctly anymore." (Ali, pers. comm., May 30, 2017)

Changes in seasonal patterns are also affecting fruit-bearing trees and reducing fruit productivity: "We have fruit trees and I notice that on certain years, with the weather warming up on February and March, they start blooming, and come April, May, a cold snap comes in . . . and that freezes the trees, and they don't produce as many fruits as before." (Cline Griggs, pers. comm.)

It is not uncommon for tribal members to completely stop farming their fields (Avery, pers. comm.; Gwendena Lee-Gatewood, pers. comm.). Avery (pers. comm.) indicates that farming practice varies within the Tribe, as the Cibecue community seems to have a bigger portion of tribal members engaged in farming. Climatic impacts are reducing farming feasibility, but other factors might also be leading tribal members to disengage from farming (Avery, pers. comm.). Gwendena Lee-Gatewood (pers. comm.) shares her personal farming difficulties:

> My family operates some farm land, situated in an area that used to get a lot of snow and the runoff from that, we used to use it for irrigation for the

crops. . . . For the past seven years or so, the water runoff, there is not enough, so when we try to plant, we don't get anything back. . . . So we don't, we haven't done that in a while.

White Mountain Apaches traditionally relied on natural irrigation, such as runoff and farming along streambeds (Leeann Lacapa, pers. comm.). In addition to reduced soil moisture, another challenge to natural irrigation stems from soil change that is occurring along streambeds as streams become narrower (Leeann Lacapa, pers. comm.). Subsistence farmers might see "no return" in investing time and resources into irrigating fields that used to be naturally irrigated (Gwendena Lee-Gatewood, pers. comm.). Hence, the land becomes unutilized. Such impacts to subsistence farming lead to an increased need to purchase food, which in turn affects households financially. This was described as "one of the biggest impacts" deriving from climate change effects to farming (Leeann Lacapa, pers. comm.).

Less available and healthy cattle

Water is regarded in Apache culture as an important element that requires respect (Basso 1996, 16; Rowena Cooya, pers. comm.). It is considered "the giver of life through Creator" (Gwendena Lee-Gatewood, pers. comm.). Tribal members perceive the diverse effects that reduced annual precipitation and soil moisture exert on the reservation. Among these is reduced nutrition and health of cattle and wildlife necessary for subsistence and for providing food for traditional events:

> The minimum moisture that we get each year. The rain, water is life, water heals, water gives life to everything. . . . When we go out and butcher for a feast, for a wake, for whatever, we take cattle off the range and the elders would say, "This one is too skinny, we didn't have a good season." . . . The amount of rain or grass that is on the range, the elders see the effect that it has on the animals that we use as food. (Cline Griggs, pers. comm.)

Wildfires can also lead to the degradation of cattle ranges and force cattle to scatter, sometimes across jurisdictions. Consequently, cattle become less accessible or less available in the reservation: "Cattle, once where they grazed, there is nothing there now. . . . Once where they had trails or where they roamed, if those areas have been hit, they now have to migrate and then if they migrate away from here, then our hunting gets affected." (Gwendena Lee-Gatewood, pers. comm.)

Less access to fishing

Reduced river water levels impede access to fishing. Consequently, tribal members are losing fish as a traditional food staple in their diets: "We would be able to go out and fish, we would eat fish all summer and you can't necessarily do that anymore because the rivers aren't running as high as they used to." (Leeann Lacapa, pers. comm.)

Wildlife less available for subsistence hunting

Reduced soil moisture and wildfire effects have consequences for elk and deer populations similar to discussed effects on cattle. Participants perceive lack of moisture to be decreasing the availability of grazing for these populations (Gwendena Lee-Gatewood, pers. comm.; Rowena Cooya, pers. comm.). This in turn leads to less healthy elk and deer, and to relocations outside of tribal boundaries.

Decreased elk and deer availability and health affect tribal members' reliance on subsistence hunting, which comprises an important source of traditional food for tribal members. This is especially impactful to tribal members who are financially vulnerable to the added expense of purchasing more store-bought foods: "The wildlife, they relocate because there is not enough grazing out there. . . . Eventually we are going to be losing this wildlife. The food that our people, you know, they don't have jobs, so they have this hunting season." (Rowena Cooya, pers. comm.)

Resources less available for traditional uses

Traditional dances are an important part of Apache identity and their conduction depends on certain resources that are becoming less available within the reservation. Leeann Lacapa (pers. comm.) describes this issue as "a very important part of who we are as a people." Reduced availability of traditional plants adds difficulties when planning and conducting traditional dances and other cultural practices, as tribal members are required to then plan more carefully and travel farther to gather such resources:

> There are limited resources for what we need for ceremonies. . . . When a girl has her Sunrise Dance Ceremony, there are roots that we need to put into our foods and things of that sort. Sometimes you have to really plan for those things and it does make it hard, I guess, when you don't have them readily available to you. (Leeann Lacapa, pers. comm.)

The reasons for this reduced availability are uncertain, but reduced precipitation and soil moisture are possible drivers (Rochelle Lacapa, pers. comm.). Tribal members are needing to travel to other tribal peoples to acquire certain resources (Ali, pers. comm.; Leeann Lacapa, pers. comm.).

Traditional plants are also necessary for their medicinal uses and for the conduction of ceremonies. Traditional resources that are necessary for ceremonies are not substitutable for the Apache (Rochelle Lacapa, pers. comm.). Potential climate effects to such resources would thus hinder Apache ceremonial and spiritual practices. The aggregated effects of these impacts may, in time, further reduce the range of Apache ritual activities and discourage cultural transmission and perpetuation:

> If some of those plants and herbs that are used in ceremony stop growing because it is not cold or wet enough, that has a direct impact on what do you use as a replacement or a supplement. Or does that ceremony just stop happening and cease to be, and what does that mean for us as a people, who rely heavily on ceremony for everything. . . . I don't know that there are alternatives because these are ceremonies that have been happening forever, if you ask Apache people, we have been doing this since the beginning of time, we don't substitute, you know, there is not a generic version of that. . . . For us, it is going to directly impact our religious beliefs and practices, because we are reliant on environment for those elements. (Rochelle Lacapa, pers. comm.)

The Sunrise Dance Ceremony is especially important as a puberty ceremony that confers girls with qualities essential for Apache female adult life, promotes female longevity, and holds other "consequences of singular importance for the entire community." (Basso 1970, 53) Among these are family and extended family cohesion through mutual support, collective blessings and wish-granting, and the establishment of a lifelong bond between the girl's family and her sponsor (Basso 1970, 53–72).

Threats to long-term water supply

Long-term water supply is a concern for the Tribe given water supply limitations since the early 2000s and regional climate change projections for water resources impacts (Cheryl Pailzote, pers. comm.). The decade 2001–2010 was the fourth driest decade since 1901 for the Southwest region, and the driest for Arizona (Hoerling et al. 2013). It is likely that Southwest regional dryness over this decade was due to a transition to negative Pacific Decadal Oscillation (PDO) and unrelated to global climate

change. However, weather stations in Arizona show an overall decrease in annual averaged precipitation during the period 1901–2010 (Hoerling et al. 2013).

Southwest annual streamflows were also lower across major drainage systems during the period 2001–2010, which Hoerling et al. (2013) attribute to a reflection of changes in precipitation, evaporation, and transpiration. Although precipitation projections are uncertain for the region, Cayan et al. (2013) report a consensus that the Southwest will experience increasingly lower spring snowpack, lower spring and summer runoff, drier summer conditions, reduced soil moisture, and intensified droughts, which will intensify the region's water demand while limiting its water resources.

Groundwater supply for the tribal community has become limited (Cheryl Pailzote, pers. comm.). The Tribe's Hydrology and Water Resources department is especially concerned about long-term water supply given climate change projections coupled with a growing population:

> We are already more limited on our water supply and that is going to put limits on our community supporting itself and growing. Those are impacts that we are already seeing right now. . . . Without long term supply of water, how do we maintain our systems? (Cheryl Pailzote, pers. comm.)

Other impacts to economic development

Impacts to economic development and other financial impacts to the Tribe through decreased recreational services and incoming tourism are discussed earlier in this section in relation to wildfire effects to forest use. There are additional impacts to the Tribe's economic development and financial situation, which stem from reduced snowfall and annual moisture. Financial impacts to the Tribe are amplified by the Tribe's current financial and unemployment difficulties (Gwendena Lee-Gatewood, pers. comm.).

Decline in snowfall and changes in seasonal patterns are affecting the tribally owned Sunrise Ski Resort's ability to schedule their ski seasons, to maintain their runs open throughout the scheduled season without significant investments in snow making, and to employ tribal members and derive profits from the Sunrise enterprise:

> The change is evident. When we talk about Sunrise, we used to have a really strong ski season starting Thanksgiving weekend and going all the way through March. This past year we were struggling at Christmas . . .

and we barely made it through the end of March. That being said, we got snow two weeks ago [May]. So we are getting these weird shifts in that you are getting snow when you don't want it and you are not getting snow when you do need it. (Rochelle Lacapa, pers. comm.)

Impacts to the ski resort affect not only the income directly generated from it, but also incoming tourism to the Tribe and prospects for training tribal members and growing tribal capacity: "If there is limited snowfall. . . . Then people won't come here to go skiing, and then they won't gamble at the casino, they will just be less and less able to come here to do those things. That affects our income and our jobs." (Gwendena Lee-Gatewood, pers. comm.)

Trophy elk hunt is another significant source of income for the Tribe (Cheryl Pailzote, pers. comm.; Gwendena Lee-Gatewood, pers. comm.). Discussed climate effects on elk health and availability are reducing the Tribe's ability to attract external hunters to boost its income:

> And one of our revenue generating things is trophy elk hunt, where non-tribal members can come hunt the elk, but like I said, they want elk with really big antlers. And because of the climate change, it is not as big of a growth. So, the hunters are starting to notice . . . the hunters are starting to draw off, so that affects our revenue. (Gwendena Lee-Gatewood, pers. comm.)

4.3. Identified Adaptation Actions

The White Mountain Apache Tribe and its tribal members are adapting to climate change effects and planning for future adaptation in diverse ways. I below describe the adaptations that are reported to me by research participants and/or publicly advertised by the Tribe. The identified adaptations are summarized in table 4.6. I deem likely that there may be other initiatives and projects in place that address areas affected by change in climate, but that are not being explicitly linked to global climate change. Therefore, this section does not intend to be exhaustive but only a point of departure for assessing and promoting tribal adaptation.

Regarding wildfire prevention, forest management, prescribed fires and monitoring of smaller wildfires without intervention are conducted to reduce forest density and clear wildfire fuel (Brenda Pusher-Begay, pers. comm., May 31, 2017; Gwendena Lee-Gatewood, pers. comm.). *The Washington Times* published an article in

2018 about the specificities and success of White Mountain Apache forest management. Forest management involving forest thinning, selective timber harvest, and prescribed and controlled burns has resulted in tribal forests that are lower in fuel density. These techniques render tribal forests less suitable for the spread of wildfires, reducing wildfire severity in the advent of local wildfires. Experts have deemed such forest management to be the reason for tribal forests' superior resilience to wildfires relative to adjacent forests ("Apaches stave off wildfires with timber industry, active forest management," Associated Press, September 2, 2018). More recently, forest management has been proposed for the Tribe's Wilderness area.

Public information and awareness play a central role in preparing for wildfires and promoting safety in the reservation (Gwendena Lee-Gatewood, pers. comm.). Preventative measures include annual awareness campaigns that inform and remind tribal members to prepare their households prior to the fire season so as to prevent possible wildfires from spreading. These measures include clearing gardens and disposing of fire wood and other flammable materials (Alexis, pers. comm.). Awareness campaigns also target evacuation preparedness. Tribal members are reminded every spring to be prepared in case an evacuation should be necessary (Alexis, pers. comm.). Evacuation preparedness involves being ready to quickly move out of one's residence in case an evacuation is needed in the area. This includes measures such as making prior plans of alternate living arrangements in other communities, pre-packing valuable and personal items, and having emergency and necessary items such as prescription drugs readily available (Alexis, pers. comm.).

When wildfires reach tribal communities, the Tribe's fire and rescue department works to contain the fire with tribal member safety as the top priority (Gwendena Lee-Gatewood, pers. comm.). External fire departments are also involved, depending on the magnitude of the wildfire. Public information is equally important in maintaining community safety during wildfires. The Tribe's public information officer is responsible for conveying wildfire information to the tribal community through radio and news channels. Information about what to do and what not to do at such times is disseminated through these channels (Gwendena Lee-Gatewood, pers. comm.).

Shortage in groundwater supply in 2002 was addressed through increase in the number of groundwater wells. This measure was successful in the short-term but the

same issue is currently reoccurring (Cheryl Pailzote, pers. comm.). Cheryl Pailzote (pers. comm.) explains that the Tribe's groundwater supply is limited and that the number of wells may be excessive for the groundwater supply, thus causing groundwater overdraft:

> In Cibecue . . . they saw that turning on one pump it was producing the maximum, but turning on three pumps, the production would drop. So we are thinking is that we are overdrafting that water now. They call it the cone of depression, where those pumps that are pumping at the same time are just decreasing the water level even more.

The negotiation of the Tribe's water rights agreement was another solution that the Tribe found for its water supply difficulties during the early 2000s:

> In 2000, 2002, we had no water, that is when we started seeing this water limitation. And the Tribe started going to different agencies, even hitting the Congressmen and asking them. And they turned around and said to the Tribe, "Negotiate your water and we will talk." So, basically they used that to get the Tribe to negotiate their water rights. Because we were one of the largest tribes who provide water in the state of Arizona, who had not negotiated their water rights at that time (Cheryl Pailzote, pers. comm.).

The White Mountain Apache Tribe Water Rights Quantification Agreement received final federal approval in 2013 (DOI 2013). The Fort Apache Reservation is located on the headwaters of the Salt River, which comprises one of Phoenix's primary sources of water. The agreement settled the Tribe's claim to 180,000 acre-feet of water from the Salt River basin annually (House Republicans 2010). The agreement allocates 27,000 acre-feet of water from the Salt and Little Colorado river, and 25,000 acre-feet from the Central Arizona Project, constituting an annual total of 52,000 acre-feet of water that is allocated to the Tribe (Gelt 2009).

The agreement also included the provision of over 200 million dollars directed at the planning, design, development, operation, and management of a rural water system to deliver water to the tribal population (DOI 2013). This provision allows for the design and construction of a dam on the North Fork of White River to boost the Tribe's water supply. The dam is currently being designed and is regarded as a long-term water supply source for the Tribe. Climate change projections are being integrated into the design of this project (Cheryl Pailzote, pers. comm.).

Long-term planning and groundwater monitoring are ongoing in some portions of the Tribe's water system (Cheryl Pailzote, pers. comm.). Long-term water resources planning was integrated into the Tribe's Water Rights Agreement through measures such as the request that external resource development activities that can impact the Tribe's groundwater be informed to the Tribe (Cheryl Pailzote, pers. comm.). According to Cheryl Pailzote (pers. comm.), long-term water resources planning involves investigating long-term water risks and planning to address those risks.

Regarding climate-induced effects to traditional farming, hunting and fishing practices, the diminished access to traditional food sources is leading tribal members to purchase more of their food (Leeann Lacapa, pers. comm.). The Tribe has invested in the development of *Ndée Bíkíyáą*, the People's Farm, to counteract reduced tribal farming and access to traditional foods. *Ndée Bíkíyáą* is founded upon the understanding that the reduction in local agricultural practices negatively affects Apache cultural identity and health (WMAT, n.d.).

With reduced availability of traditional resources within the reservation, tribal members are coping with added difficulties to gather needed resources for ceremonies. This involves the need for additional planning to access these resources prior to ceremonies, which at times includes dislocating outside of reservation boundaries and interacting with other tribal peoples (Ali, pers. comm.; Leeann Lacapa, pers. comm.).

Lastly, the Sunrise Park Resort is adapting to changes in snowfall quantity and timing by diversifying services and attractions beyond winter activities to spur year-round tourism and revenue (Rochelle Lacapa, pers. comm.). Rochelle Lacapa (pers. comm.) points to the fact that "the winter sport industry as a whole is looking at reinventing itself."

Table 4-6.　　Identified adaptation actions

Addressed areas	Adaptation actions
Wildfires	Wildfire public communication
	Evacuation preparedness
	Forest management and prescribed burnings
	Preventative measures for wildfires
	Mount Baldy area management
Water supply	Increase in groundwater wells
	Monitoring wells & long-term groundwater planning
	Water rights settlement
	Dam development for long-term water supply
Food security	Diversification of food sources
	Community farming
Traditional resources	Adaptation of cultural practices to environmental changes
Economic development	Diversification of ski resort attractions

4.4. Adaptation Opportunities

Adaptation opportunities are understood here as actions that enable community adaptation (Klein et al. 2014) or that support community adaptive capacity.

Localized climate education

Climate change awareness has been identified as an adaptation enabler that is consistent across different contexts (Klein et al., 2014). In this case study, participants report that a relevant portion of the tribal population is not sufficiently informed about global climate change (Gwendena Lee-Gatewood, pers. comm.; Leeann Lacapa, pers. comm.). Older generations are described as especially little informed about climate change. Certain communities within the Tribe are also particularly isolated from external information: "Some of the communities are secluded, people don't really get around, they are lacking the news maybe." (Gwendena Lee-Gatewood, pers. comm.) Those who are informed do not necessarily make the connection between global climate change and local climate effects:

> To hear about climate change, the first thing we think of is in Alaska, the ice is melting, that type, we don't see it at our level. How it is impacting us. So it would be good to educate our people, at our level this is what we are seeing. . . . So, I think that is what is holding the Tribe back. (Brenda Pusher-Begay, pers. comm.)

Becoming informed about climate change and about the impacts at the tribal scope is the first step for a bigger portion of tribal members to be proactive in adaptation efforts: "The people need to start being part of that change, helping incorporate it. But without education, without being told what it is about, I think they will be like, 'That is someone else's problem.' " (Gwendena Lee-Gatewood, pers. comm.)

Sydneysmith and Matthews (2011, 52) found a similar barrier among First Nations in Canada—what they term "not a local problem." The authors state that community members frequently perceive climate change as a global rather than a local problem and often miss connections between global climate change and local issues. Community members' reasoning then follows that, if climate change is a "geographically remote" issue, then it is wiser to spend scarce local resources in other, more locally relevant, matters (Sydneysmith and Matthews 2011, 52). In conclusion, the lack of *localization* of climate change leads to its discounting as an issue that is not worthy of attention. This study suggests a similar attitude of climate change being "someone else's problem" when this issue is not being localized (Gwendena Lee-Gatewood, pers. comm.).

Tribal members are especially unaware of climate change effects to traditional resources in the reservation (Leeann Lacapa, pers. comm.; Rochelle Lacapa, pers. comm.). However, potential effects to needed resources for ceremonies would be detrimental to tribal members' spiritual and religious practices:

> No one in this country says, "How will climate change impact my religious beliefs and practices?" For us, it is going to directly impact our religious beliefs and practices, because we are reliant on environment for those elements. It would be like if in the catholic faith there was a shortage in . . . sacramental crackers and wine, what would you do then? . . . I think that for us we just haven't made that direct correlation. (Rochelle Lacapa, pers. comm.)

Leeann Lacapa (pers. comm.) deems climate change to be culturally relevant to the White Mountain Apache, "because when you think about Apache history and Apache lifestyle and culture, it really revolves around your environment." It is important for climate change to be perceived as culturally relevant so that people recognize it as an important issue for themselves and the Tribe (Leeann Lacapa, pers. comm.). Discussion of climate effects on traditional practices comprises an opportunity to connect the topic of climate change to White Mountain Apache environment and culture.

Promotion of Apache culture and heritage

Apache way of life has profoundly changed since the establishment of the Fort
Apache Reservation in the late 1800s (Basso 1970). Historical changes include but are
not limited to decline in Apache language usage, loss of traditional knowledge, disruption
of Apache way of life, loss of land and traditional resources, decline in Apache values
(e.g., respect for nature), changes to the connection with nature, and disconnection to
Apache cultural identity (Angel, pers. comm.; Cline Griggs, pers. comm.; Gwendena
Lee-Gatewood, pers. comm.). Contact with Western culture still exerts an ongoing,
analogous effect of Apache linguistic and cultural disruption (Cline Griggs, pers. comm.;
Welch and Riley 2001). Participants express a decline in Apache identity in the
reservation, which exerts detrimental effects on tribal members:

> The most important thing is that our people are losing their heritage here.
> The way we used to live, respecting the land. And if you lose your Apache
> identity, you don't have anything. And that is what the Army put in place a
> hundred years ago, for us to lose our culture, our language. . . . What
> happened then is acting today, our people don't know who they are. (Angel,
> pers. comm.)

Cline Griggs (pers. comm.) also points to profound changes to Apache (*Ndee*)
identity and consequent negative effects to tribal members' sense of belonging.
Changes in the way people self-identify are related to the fact that the word "Apache"
originally meant "enemy" in native language:

> Our younger generations are not taught of who they are, to self-identity.
> They are told or exposed to certain things that are taking them away from
> who they are, even today. . . . Taking them out and telling them, "You are
> a human being." . . . "Apache" means enemy. Once the generation
> understands that they are a human being and that they are part of this
> world, they will start taking care of this world.

Promotion of Apache culture aims to offset historical attacks to and erosion of
Apache culture and way of life. The promotion of Apache culture holds potential to curb
socioeconomic difficulties—e.g., brain drain and individual/household vulnerability
stemming from unemployment—, thus promoting tribal adaptive capacity. Karl Hoerig
(pers. comm., May 24, 2017) identifies "strength and pride in heritage and family" as a
reason that encourages tribal members to remain in the reservation, and to direct efforts
for its betterment. In a similar direction, Gwendena Lee-Gatewood (pers. comm.)

exemplifies how the connection to ancestors and pride in Apache heritage can increase youth adaptive capacity and morale:

> I sit them [students] down and say, . . . "What does the word impossible say to you?", and they are like, "I can't do it." I say, "You can't do it and you can do it. Both of them are true. Which one are you going to be? . . . Your ancestors, they endured, they were strong. . . . You shouldn't have that just going to give up attitude, because that is not what our ancestors were about. You are here to learn, and once you learn, you are going to help your people again."

Disconnection between Apache people and their culture and natural environment is also directly related to change in climate according to traditional Apache explanations. The traditional explanation for changes in climate and in the environment involves the loss of respect for nature and its seasonal cycles (Cline Griggs, pers. comm.; Rowena Cooya, pers. comm.). The loss of respect and disobedience of Apache rules has affected the reciprocal relationship that Apache people maintained with their local environments since time immemorial. Hence, this relationship needs to be restored for local climatic changes to be addressed:

> Try to obey whatever rules that they have about it, and trying to teach the younger generations the changes that I see and the effects that are happening, and the reason why it is happening, of us and the Apache people not honoring what we were given to live our life with. . . . I think if we are adapting to the climate change, we need to get back to what we were given. (Cline Griggs, pers. comm.)

The promotion of Apache culture is beneficial not only to the White Mountain Apache in restoring their connections to the environment and seasonal cycles, but also to the maintenance of seasonal cycles on a broader scale. Apache cultural practices are performed for the betterment of the Earth as a whole: "These dances are done for all mankind, the whole mother Earth. When you look at one mother Earth, there are no boundaries." (Ali, pers. comm.)

Revitalization of Apache ties to local environments additionally spurs the community to act as traditional land and resource stewards. This is important, given reported patterns of resource overexploitation and pollution in the reservation, which add to cumulative impacts to the local environment (Angel, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Rowena Cooya, pers. comm.). Educational efforts and intergenerational knowledge transfer are necessary for this revitalization to occur: "I think

we need to start with the pollution that they are doing. . . . We are destroying ourselves, if we keep doing that. . . . We need to re-educate how important and valuable the land is." (Rowena Cooya, pers. comm.)

Lastly, promotion of Apache culture involves the perpetuation of traditional knowledge that is valuable for tribal climate adaptation:

> The way fire works, the way his grandfather told him, that it does this complete circle, so in order for that process to finish itself, this part has to someday burn. . . . But if we don't prepare ourselves and prepare the land, then it will be a really big fire and we will lose a lot. Those types of things that come from our elders, the cultural aspect of how things move, that is dying off. And now I think a younger person who is a firefighter probably wouldn't know that. (Gwendena Lee-Gatewood, pers. comm.)

Tourism and economic development

The Tribe is currently suffering from financial and employment difficulties (Gwendena Lee-Gatewood, pers. comm.; Krista Beazley, pers. comm.; Rochelle Lacapa, pers. comm., Shannon Tsosie, pers. comm.). These are some of the causes leading to social problems that have become pervasive within the tribal community, such as substance abuse, suicide, interpersonal violence, and family unit disintegration. Gwendena Lee-Gatewood (pers. comm.) explains how these issues are connected:

> I know there is a lack of employment. Because of this, people don't have anything to look forward to, as in putting in a hard day's work and getting paid for their efforts, so then they turn to ways to cope with that, and unfortunately some turn to drugs and alcohol. . . . And because we have a problem with drugs and alcohol, we then have a problem with people that give up and commit suicide.

Socioeconomic difficulties, in turn, increase tribal members' individual and household vulnerability and lower adaptive capacity to face additional challenges, such as climate change effects. They also hinder people's engagement in proactively planning for the future. Issues such as climate adaptation are consequently overshadowed by more pressing difficulties. In Karl Hoerig's (pers. comm.) words, "This is why climate change isn't such a big deal that people care about."

The Tribe's economic dependence on natural resources increases its financial vulnerability to climate effects, which can result in further unemployment and financial

difficulties as climate change effects advance. This is apparent in the financial losses resulting from the Tribe's sawmill closures following the Rodeo-Chediski fire in 2002 (Shannon Tsosie, pers. comm.). Tribal financial vulnerability, in turn, incentivizes tribal members to further explore natural resources in unsustainable ways (Angel, pers. comm.; Gwendena Lee-Gatewood, pers. comm.). Angel (pers. comm.) mentions tribal members poaching deer and elk to sell their antlers as they face financial difficulties, in spite of deer and elk populations being already heavily hunted and "stressed out." Gwendena Lee-Gatewood (pers. comm.) highlights that "an overrun of tribal members" cut juniper trees "that were so precious to the Tribe" in order to sell wood.

Investment in economic development and tourism lowers the Tribe's economic dependence on natural resources, as well as tribal resource management dependence on external funding sources that are currently dwindling (Brenda Pusher-Begay, pers. comm.; Cheryl Pailzote, pers. comm.). Economic development and tourism would inherently increase adaptive capacity through employment creation, given reported increased vulnerability stemming from high unemployment rates. Additionally, revenue generated by the Tribe can be invested into key areas for adaptive capacity, such as (i) continuation and expansion of natural resource management programs to account for climatic changes (Brenda Pusher-Begay, pers. comm.), and (ii) youth development and health promotion (Ali, pers. comm.).

Investment in youth

Participants portray youth as being more open to learning and to behavioral changes than older generations, including regarding climate education (Cline Griggs, pers. comm.; Gwendena Lee-Gatewood, pers. comm.). Investment in younger generations' education can spur climate awareness as well as promote intergenerational knowledge transfer needed to bridge generational gaps:

> Start with the young ones. Us old ones, we are too stubborn. Some don't want to learn. But if you get the young ones and teach them, and they will teach the old ones. . . . So teach the youth, and they will teach the elders, and whatever knowledge they have, they will start teaching the younger ones. (Cline Griggs, pers. comm.)

In spite of youth's potential for learning and behavioral change, the socioeconomic difficulties explored in the previous sections have affected younger

generations' development. Ali (pers. comm.) explains how a feeling of lack of purpose among younger generations is leading to increase in alcoholism and suicide rates. This is similar to Gwendena Lee-Gatewood's (pers. comm.) analysis of unemployment leading to alcohol and substance abuse through a feeling of lack of purpose, or not having "anything to look forward to." In Ali's (pers. comm.) words, the youth "are sick, that is how our elders explain it, they are not healthy. Their minds are not there, their bodies are not there, there is no cohesion. We need to heal them." This constitutes an especially concerning issue for tribal adaptive capacity in a changing climate, as these generations will likely cope with increasing climate effects.

Participants express a need to invest in younger generations to revive Apache teachings and values and to restore the tribal community as a whole. Investment in younger generations is expressed as particularly important to support the Tribe's future adaptive capacity:

> I think the people need to get back together, work together and work on our younger generation, because our younger generation is where it starts to me. . . . It would be nice to at a young age instill in these younger generations to aim for something higher than what is going on in the reservation. Go to school, get an education, and help the Tribe. (Krista Beazley, pers. comm.)

4.5. Organizational Roles

This section describes the roles that participants identify as being currently or potentially led by the Fort Apache Heritage Foundation to support the tribal community in adapting to climate change effects and to foster tribal adaptive capacity. I also include responses regarding Fort Apache's roles in supporting the Tribe as the site that is managed by the Foundation. Links between organizational roles and support of adaptation opportunities are further explored in section 4.6.

Fort Apache is being envisioned as a community centre that can strengthen the Tribe's adaptive capacity by promoting recreation, education, and a sense of community (Karl Hoerig, pers. comm.; Krista Beazley, pers. comm.). Through providing these services, Fort Apache can prompt community ties restoration, health and well-being improvement, and the betterment of younger generations:

> Making Fort Apache into a community center. . . . A central park where there is recreation that happens, but also facilities for community education. . . . I see it as becoming a safe and nice place for things to happen in the community. It should be a place where good things can happen for the community. (Karl Hoerig, pers. comm.)

Participants perceive Fort Apache as a site that is well located to become a community centre and a place to develop business opportunities for the Tribe (Ali, pers. comm.; Krista Beazley, pers. comm.). Fort Apache's tourism and economic development potential is relevant for tribal employment and income generation, which are needed to increase adaptive capacity (Ali, pers. comm.; Gwendena Lee-Gatewood, pers. comm.). Fort Apache's income generation would also be invested in its development as a community centre: "If we get those funds coming in, we can develop this place a little bit more, for the community and the tourism. Those are my two targeted populations that I have to concentrate on right now." (Krista Beazley, pers. comm.)

Fort Apache's tourism potential has other benefits beyond income and employment generation. The Foundation and *Nohwike' Bágowa* (House of Our Footprints), the Tribe's Cultural Center and Museum at Fort Apache, support the Tribe by fostering external awareness of Apache people and values so as to draw tourism and partnerships to the Tribe. Apache awareness raising and external network facilitation are valuable to develop the Tribe's capacity:

> Not everyone in the world knows who is Apache, why are they so important, that distribution of who we are I think that is going to really help. . . . And that draws people here, and the more people that are drawn here, the more awareness is out there, and then maybe that will help us generate relationships, partnerships, income. (Gwendena Lee-Gatewood, pers. comm.)

The need for climate education and awareness is consistently reported by participants (Alexis, pers. comm.; Brenda Pusher-Begay, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Leeann Lacapa, pers. comm.; Rochelle Lacapa, pers. comm.). A climate education project is a role that the Foundation could develop to support the community in becoming more aware of climate effects to the reservation, and more proactive in adapting to such effects. Connecting tribal members to the land through language, culture, and environmental education is relevant to the Foundation's mission within Fort Apache (FAHF 2015). Ideally, a climate education project would integrate all three of these aspects:

What the Foundation is doing, some cultural stuff. . . . It could be more of that, educate the people about the environment and also about our heritage. . . . We should have Apache language teaching here. That ties us to our land, our language. . . . But because of funds, we are not doing it. (Angel, pers. comm.)

Awareness campaigns are also mentioned as effective means of raising awareness of climate effects to the Tribe. The Foundation has the opportunity to disseminate information not only to tribal members, but also to tourists who visit Fort Apache: "They could set up a display or have someone talking about climate change to people who come here to visit. Because there are a lot of people from the outside that they could spread the word to." (Alexis, pers. comm.)

Awareness campaigns focusing on the connection between climate change and Apache culture would be particularly impactful: "Awareness campaigns. . . . If you want to make people aware around climate change, I think it has to be as innately tied to who we are as people as something like our language. You don't know the culture, because you don't understand how climate is impacting how we interact with the culture." (Rochelle Lacapa, pers. comm.)

Regarding cultural education and promotion, the Foundation is already involved in cultural education and interpretation through support of the Tribe's Cultural Center and Museum. The Foundation's continuing support of these services is described as critical, given that tribal financial support to the museum has decreased over time: "Seven or eight years ago the museum lost about forty per cent of its staff time. Our [museum] staff all don't work full time because the Tribe can't afford to pay them full time, and yet we still have a lot of stuff to do. Finding ways to support that continues to be really critical." (Karl Hoerig, pers. comm.)

The Foundation also holds potential to develop tribal capacity by sponsoring student interns (Rochelle Lacapa, pers. comm.). Especially relevant here is to support the Tribe's environmental and climate expertise, which is currently insufficient to mainstream climate change projections and considerations into existing programs and organizations (Brenda Pusher-Begay, pers. comm.; Rochelle Lacapa, pers. comm.). Rochelle Lacapa (pers. comm.) explains that the Foundation could support such efforts by leveraging its academic and funding connections to sponsor the integration of students within tribal organizations to develop adaptation mainstreaming. The benefits

would be dual—advancing tribal capacity while supporting climate change adaptation strategies. This idea is mentioned in relation to for-profit tribal organizations, but this would be equally applicable to resource management departments:

> I can see the Foundation in partnerships with organizations like Sunrise or Hon-Dah [Resort Casino and Conference Center] sponsoring college interns. . . . Tapping them into organizations and then. . . . How do we look at this . . . how does climate change impact your work? How do you approach and be a better steward? And wrap it in just the same way we wrap in things like financial management and cultural integrity to interns, to me climate change and awareness should be just as integrated as these other elements. (Rochelle Lacapa, pers. comm.)

Cooperation among tribal resource management departments is equally identified as insufficient for tribal climate adaptation (Brenda Pusher-Begay, pers. comm.; Cheryl Pailzote, pers. comm.). It is suggested that the Foundation, as an external actor, might be well-suited to spur and facilitate discussions around climate change among different departments and interested organizations within the Tribe. This is also compatible to the vision of developing Fort Apache as a place to remember the tribal past but also envision tribal futures. This could be stimulated by the coordination of a climate change seminar or workshop that is of interest to departmental staff:

> I think that somebody coming in and kind of just like getting that group together and talking, I think that would work. But if it was another program trying to get this going, I don't think that would happen. . . . I think if we all tried to have the Foundation facilitate something like that to get these issues addressed, that would work easier. (Brenda Pusher-Begay, pers. comm.)

In spite of this series of potential roles that the Foundation can play to further support the tribal community's adaptive capacity in a changing climate, some participants advise against the involvement in climate adaptation in any way that stretches the Foundation's mission (Ali, pers. comm.; Karl Hoerig, pers. comm.). The Foundation is pivotal for the maintenance and continuing development of the Fort Apache site, and is advised to keep focusing its main efforts on site development:

> I was very concerned about overstretching the capacities of the organization by trying to do too much. And I think it is a very real threat now that the Foundation will overstretch its capacities. . . . And if you start to neglect the property, if you start to not keep a focus on this, there is real risk of serious harm happening. (Karl Hoerig, pers. comm.)

4.6. Recommendations

This section summarizes the results described in this chapter as the bases for recommendations for the betterment of the tribal community in a changing climate and, more specifically, for the ways in which the Foundation can support the tribal community in this regard. Recommendations to the tribal community should be taken as partial suggestions, given that research methods were developed from an organizational viewpoint, did not delve into specificities of sub-communities within the Tribe, and therefore cannot represent the diversity of tribal views.

As a natural progression from the presentation of participants' responses, this final section allows for more researcher subjectivity, interpretations, and suggestions as a complement to the information derived from the interviews. I structure the recommendations based on (i) reported climate effects and associated adaptation actions (or lack thereof), and (ii) adaptation opportunities and their interconnections to organizational roles.

Reported climate effects and adaptation actions

As described and listed in section 4.3, identified adaptation actions mainly address wildfire and water supply effects. Hence, initiatives targeted at remaining clusters of climate effects would fill in adaptation gaps in the tribal community.

Traditional food security is being imperiled by multiple effects on traditional practices, including on farming, cattle herding, subsistence hunting, and fishing. These impacts are concerning given that community members rely on such practices for their food security. The tribal community would be more prepared to adapt to these effects if tribal members discuss these issues and plan for food security and traditional food enhancement as a collective. This could involve planning and implementation of, for example, more community greenhouse or farming projects (such as *Ndée Bíkíyáą*, the People's Farm), changes in farming practices to cope with decreased rainfall and runoff, incentives for tribal member farming initiatives, or use of public spaces for community gardens. As a developing community centre, Fort Apache could become a space to promote needed collective discussions to shape visions of tribal futures.

Participants indicate that needed traditional resources for dances, ceremonies, and medicinal purposes are possibly being impacted by drier weather conditions and are becoming less available or unavailable within the reservation (Ali, pers. comm.; Leeann Lacapa, pers. comm.; Rowena Cooya, pers. comm.). Development of traditional resource monitoring would be an important first step in protecting these resources and in understanding the effect of climatic changes upon their availability. Additionally, integration of traditional resources topics into local climate and environmental education is essential for tribal members to be aware of changes to their availability and to exercise stewardship. This is particularly important, as participants deem that tribal members are often not perceiving the connection between climatic changes and decreased availability of traditional resources (Leeann Lacapa, pers. comm.; Rochelle Lacapa, pers. comm.).

Regarding the Foundation's roles, I recommend that a potential climate education project incorporate learning about traditional resources that are needed for specific Apache ceremonies, their climatic and environmental specificities, as well as stewardship concepts and practices. If a climate education project were incorporated as a recurring activity with an experiential learning component, it could also provide hands-on capacity for traditional resource monitoring. A related possibility would be for the Foundation to promote traditional resource stewardship in the Fort Apache property, such as through development of traditional plants inventories within the property.

Mount Baldy is especially relevant to the tribal community for its spiritual significance, ecological importance as habitat for traditional resources, and contribution to the Tribe's water supply. Increase in the frequency of wildfires in the reservation raises concerns about wildfire threats to the Wilderness area (Angel, pers. comm.; Cheryl Pailzote, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Rochelle Lacapa, pers. comm.). Given participants' emphasis on the negative effects that a wildfire in this area would exert on the Tribe, I would recommend that addressing this particular threat be a priority. Participants express that forest management is needed in the area to reduce wildfire severity and potential. If the Foundation decides to take on the role of an interdepartmental facilitator, this would be an important target for cooperation.

Table 4.7 summarizes conclusions and proposed recommendations for the tribal community and for the Foundation, stemming from the analysis of reported effects on the tribal community and of identified adaptation actions.

Table 4-7.   Conclusions and recommendations

	Conclusions and Recommendations
Tribal community	• The tribal community is likely to benefit from food security planning. • The tribal community is likely to benefit from traditional resource monitoring, awareness, and stewardship. • Preventative measures to reduce potential wildfire severity in the Wilderness area should be a priority.
Fort Apache Heritage Foundation	• Fort Apache's development as a community centre can support tribal adaptation as a site for needed collective discussions of tribal futures. • A climate education project should incorporate information on traditional resources. Traditional resource monitoring and stewardship could add to an educational project as well as improve Fort Apache's stewardship capacity.

Adaptation opportunities

I proceed to expand on each adaptation opportunity and on how identified organizational roles can promote them. However, instead of dedicating a section to the "investment in youth" adaptation opportunity (see section 4.4), I choose to integrate this topic within the sections dedicated to the remaining adaptation opportunities. Youth is described as the portion of the tribal community that most needs investments for the promotion of their health, development, and growth, which would in turn strengthen community adaptive capacity (Ali, pers. comm.; Cline Griggs, pers. comm.; Krista Beazley, pers. comm.). I integrate this topic within the remaining opportunities, given that many organizational roles and actions portrayed here can be designed with a specific focus on youth, their needs, capacities, and development. Hence, there is overlap between actions taken to promote this opportunity and actions taken to promote other identified opportunities.

Localized climate education

Participants express a lack of climate change information and awareness in the tribal community. Especially lacking is localized climate change information that enables community members to draw connections between global climate change and impacts to the reservation and to Apache culture (Alexis, pers. comm.; Brenda Pusher-Begay, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Leeann Lacapa, pers. comm.).

The Foundation could strengthen this adaptation opportunity through a climate education role. Participants report climate education projects focused on youth and awareness campaigns in Fort Apache as two possibilities that would fulfil this role. An ideal climate education project is described by participants as one that is focused on youth, is able to attract youth's attention and to better connect them to the local natural environment, and that integrates climate and environmental education, Apache cultural education, and Apache language usage.

Regarding a climate education project for youth, participants provide a plurality of ideas and considerations for climate education. Alexis (pers. comm.) advises leveraging the summertime, when students are not in school, to offer shorter educational sessions on this topic, with a focus on emergency preparedness so that youth is informed of what to do (and not to do) in the event of a wildfire or flood. In spite of placing an emphasis on the value of education, Alexis (pers. comm.) deems that "education is hard to attain for a lot of our tribal people, so it is going to take a long time to make changes."

Participants emphasize the importance of connecting desired learning topics to Apache culture and language in order to incite interest and engagement in the learning process (Leeann Lacapa, pers. comm.; Rochelle Lacapa, pers. comm.). In this sense, threats to traditional resources and their connections to Apache ceremony, spiritual practice, and religion would be suitable as a learning focus. Rochelle Lacapa (pers. comm.) also suggests that not explicitly focusing on the topic of climate change, but rather integrating climate change effects and projections into the study of traditional resources stewardship would be more beneficial, given climate change politicization in the United States.

Participants also place importance on practical experience and interaction with local landscape while learning (Gwendena Lee-Gatewood, pers. comm.; Karl Hoerig, pers. comm.). In Gwendena Lee-Gatewood's (pers. comm.) words, "You have to approach things in a way that they [students] are the ones contributing positively." It is important that climate education be not only informative but empowering. Such a project could be designed with the dual purpose of promoting climate change awareness and empowering students of the Theodore Roosevelt School, which faces stigma as a former residential school (John Welch, pers. comm., May 26, 2017).

I suggest that integrating climate education with student project development for adaptation purposes would be a particularly suitable and empowering approach. Student project development could take the format of, for example, traditional resource stewardship, intergenerational knowledge transfer and recording, local environmental monitoring, or traditional resource inventories development. In a similar vein, Shannon Tsosie (pers. comm.) questions whether "in ten years from now, do we know if there are going to be piñons, or acorn, or any of the berries, stuff that some people still use. What can we do to be able to preserve those plants?" Posing those kinds of questions that incite community adaptation could have positive effects for cultural perpetuation.

Intergenerational communication and knowledge transfer is described as an important but currently insufficient aspect of Apache life and culture. Improving intergenerational communication would be foundational for youth development both within and beyond an educational setting. According to Cline Griggs (pers. comm.), "Teaching them [younger generations] to respect what is out there. . . . That is one of the things elders are needing to do, is to teach what they have before they go into the next world." Krista Beazley (pers. comm.) emphasizes the importance of "bringing back the times we used to tell stories to the kids from an elder." In a climate education context, elders would be able to provide youth with a first-hand description of change in local climate and in the reservation's environment within the past few decades (Ali, pers. comm.). Intergenerational communication is vital to perpetuate and revitalize Apache connection to and respect of nature (Cline Griggs, pers. comm.; Rowena Cooya, pers. comm.).

Leeann Lacapa (pers. comm.) cautions for the need to consider Apache culture and norms when designing an educational project. This includes consideration of appropriate gender roles and of seasonal cycles of Apache activities. It is important to be aware that "there are certain things you do during certain times of the year and there are certain things you don't do." (Leeann Lacapa, pers. comm.) This relates to the traditional Apache explanation that disrespect of seasonal cycles is "confusing mother nature" and leading to local climatic changes (Cline Griggs, pers. comm.). Hence, the integration of Apache seasonal cycle learning into a climate education project seems particularly suitable.

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Awareness campaigns are reported as another possibility that would leverage Fort Apache and the influx of people it receives to spread awareness of climate change effects to the reservation (Alexis, pers. comm.; Brenda Pusher-Begay, pers. comm.; Rochelle Lacapa, pers. comm.). An awareness campaign could incorporate some of the mentioned considerations for a climate education project. For example, an awareness campaign would similarly benefit from delivering a message that is connected to Apache culture and language, and from incorporating elder knowledge as appropriate.

Promotion of Apache culture and heritage

The White Mountain Apaches have been significantly affected by colonial processes that separated them from their traditional territories, traditional knowledge, language, cultural values, and social ties (Angel, pers. comm.; Avery, pers. comm.; Rowena Cooya, pers. comm.). This separation has been detrimental to tribal members' cultural identity, connection to the local environment, and well-being (Angel, pers. comm.; Cline Griggs, pers. comm.). Loss of language is emphasized by participants as a process that exerts significant negative effects on Apache culture and identity: "The people, they are beginning to lose the identity of who they really are. And one of the first areas that I am seeing is our language. . . . Our language is gradually dying, and if that happens, the domino effect of total destruction has started." (Cline Griggs, pers. comm.) The promotion of Apache language, culture, and heritage is paramount to the tribal community's Apache identity and adaptive capacity (Gwendena Lee-Gatewood, pers. comm.). It can revitalize connections to local environment and perpetuate Apache values and traditional knowledge that foster adaptive capacity (Gwendena Lee-Gatewood, pers. comm.; Rowena Cooya, pers. comm.).

The Foundation is already supporting and revitalizing Apache culture and heritage through management of the Fort Apache National Historic Landmark. The revitalization of this site of military occupation and residential school system into a place that promotes heritage and serves as a symbol of Apache pride and sovereignty supports Apache culture and heritage (Leeann Lacapa, pers. comm.; Mahaney and Welch 2002). The Foundation's role is in this way connected to White Mountain Apache past as well as to its future. The former involves preserving Fort Apache history and physical structure and educating tribal members and visitors about this history—acting as a "keeper and protector of the . . . history and culture" of the White Mountain Apache

(Leeann Lacapa, pers. comm.). At the same time, the revitalization of Fort Apache into a symbol of endurance and thriving over the colonial past and of "owning that past" enables shifting this site's negative connotation into its perception as a statement of present and future sovereignty (Rochelle Lacapa, pers. comm.). In Rochelle Lacapa's (pers. comm.) words, "We are working to changing that perception within that community and making Fort Apache a place that is owned by the community. Here is how we take something that was very negative and make it something that is really positive for the community and help the community move forward."

Participants express that, although the Foundation has been essential in restoring Fort Apache, there still lies work ahead in integrating this site into the wider tribal community and in changing tribal members' site perception (Alexis, pers. comm.; Brenda Pusher-Begay, pers. comm.; Cheryl Pailzote, pers. comm.; Leeann Lacapa, pers. comm.; Rochelle Lacapa, pers. comm.). Alexis (pers. comm.) deems that "all people need to know that our parents and grandparents went to school here, and they need to learn about what happened here." Gwendena Lee-Gatewood (pers. comm.) refers to the Theodore Roosevelt School as a testament of ancestors that "endured the hardships and . . . still made something of themselves." This provides the opportunity for tribal members to think of themselves as a living legacy of such ancestors and as likewise enduring and strong (Gwendena Lee-Gatewood, pers. comm.).

Moving from the past to the future entails reinventing the site as "a community space that is owned by the community. . . . That the community feels ownership of and actively engages and participates with." (Rochelle Lacapa, pers. comm.). This involves developing Fort Apache into a community centre (Karl Hoerig, pers. comm.; Krista Beazley, pers. comm.) and a place to discuss and envision desired and sustainable tribal futures (John Welch, pers. comm.).

Transforming Fort Apache into a community centre is part of the Foundation's Master Plan (FAHF 2015). This includes having a public park space, providing recreational and educational programs and services, and promoting safety on the site (Karl Hoerig, pers. comm.). Incorporating designated space for cultural activities is also being considered (Rochelle Lacapa, pers. comm.). A community centre can be especially directed to the betterment of children and youth through the development of recreational park space, space for sports activities, and other suitable recreational

services, such as movie theaters (Ali, pers. comm.; Krista Beazley, pers. comm.). Promotion of nature-centered activities, such as trails and bird-watching, are also being considered (Krista Beazley, pers. comm.). A wider variety of recreational and educational opportunities would improve youth health and well-being, as well as connection to local environments.

The Foundation is moving from an emphasis on heritage tourism and towards the adaptive reuse of Fort Apache's buildings and grounds as a community centre for the Tribe and its members (Welch 2019). It is still unclear whether the Foundation will act in the future as a service or grant provider (Rochelle Lacapa, pers. comm.), and future roles and initiatives are dependent on funding and personnel resources (Krista Beazley, pers. comm.).

Given the reported importance of culture and heritage promotion to adaptive capacity enhancement, I would recommend that the Foundation continue to target its roles and initiatives to this end. This includes current aims to integrate cultural components into community centre development as well as ongoing support of the Tribe's Cultural Center and Museum (Karl Hoerig, pers. comm.). Future initiatives could leverage the Foundation's position as site manager to give preference to tenants that invest in or promote cultural activities and language perpetuation. Fort Apache holds the potential to develop into not only an important space for visitors and tribal members to learn about the Tribe's past, but a place where Apache cultural perpetuation, recreation, opportunities for well-being and networking, and collective dialogues guide the tribal community into a sustainable tribal future.

Tourism and economic development

Developing the Tribe's economic and tourism opportunities is essential for the Tribe to overcome its socioeconomic difficulties, which are lowering tribal adaptive capacity (Gwendena Lee-Gatewood, pers. comm.; Karl Hoerig, pers. comm.). A more economically diverse and financially independent Tribe would be less vulnerable to financial effects of climatic changes, as well as more financially able to plan and implement needed adaptations (Brenda Pusher-Begay, pers. comm.; Cheryl Pailzote, pers. comm.).

The Foundation is promoting this adaptation opportunity by investing in Fort Apache's tourism and economic development potential. Krista Beazley (pers. comm.) expresses that the Foundation has a portfolio of ideas to attract funding to the Foundation and to use this funding to generate tourism and income. Fort Apache's development as a community centre (discussed in the previous section) can in itself attract tourism and businesses to Fort Apache. A suggestion suitable to Fort Apache's tourism experience enhancement is site beautification (Alexis, pers. comm.; Avery, pers. comm.). Suggestions include planting trees and maintaining the central field (Alexis, pers. comm.; Avery, pers. comm.). Alexis (pers. comm.) comments that "this is a historical place and it is here for the people to enjoy"—an aesthetically pleasing environment may be a factor in people's enjoyment of the site. Alexis (pers. comm.) recognizes the difference that the Foundation has made for the site in this regard: "It [Fort Apache] looks much more beautiful than when I was a teenager."

It is important that tourism and economic development initiatives be mindful of cumulative pressures upon the Tribe's natural resources, including climate change effects. The Foundation holds potential to guide tourism and economic development towards sustainability and away from resource overexploitation. This is an added opportunity for the Foundation to act as a role model for other tribal organizations (Angel, pers. comm.)—in this case as a steward of Fort Apache's natural and traditional resources.

The Foundation has integrated environmental resource perpetuation into its Master Plan as a function of heritage perpetuation, thus recognizing the intricacy of Apache land, environment, and culture (FAHF 2015). I would recommend this be translated as integrating stewardship of Fort Apache's natural and traditional resources into site planning and tenancy policy:

> If we are talking about creating Fort Apache as a town space . . . how do you establish towns or community centers so that you have all the amenities while still allowing for open green space . . . that can be utilized and can be beautiful, but has low use of water or electricity. Looking at the entire property, what do we identify as untouched open space, where do we identify ceremonial space. . . . To me that is how we build out the entire property, is thinking comprehensively—here is how we are going to use this space, here are the types of tenants we recruit, here are the types of resources we use within this space, and tenants who come here need to

be on board with that same vision and mission (Rochelle Lacapa, pers. comm.).

Some ways that a stewardship mission could be explicitly directed to climate adaptation include partnering with the Tribe's Hydrology and Water Resources department to (i) implement water demand management throughout Fort Apache, and (ii) identify further opportunities to protect tribal water sources and water quality within the site. Focusing on water stewardship would be especially suitable given long-term climate change effects to water supply, as well as Apache respect for and value of water. Identifying Fort Apache zones that comprise traditional plant habitat or that would be suitable for traditional plant habitat, and protecting these zones for this function, is an additional possibility. As Rochelle Lacapa (pers. comm.) discerns, integrating stewardship into site planning and policy is a more long-term impactful initiative than any discrete projects that the Foundation could spouse or fund:

> To me it is creating the tapestry of Fort Apache and these are all the fibers that go into it, so it doesn't just become a block on the quill. This is so ingrained that it is actually part of the fibers, the fibers are economic development and culture, and these are woven into every element.

Chapter 5.

Discussion

This research project involved engagement with two North American Indigenous-owned organizations that share cultural stewardship missions—the Stó:lō Research and Resource Management Centre (Stó:lō Nation, BC) and the Fort Apache Heritage Foundation (White Mountain Apache Tribe, AZ). Engagement with the participant organizations and semi-structured interviews with their representatives and clients resulted in recommendations for these organizations to support the communities they serve in adapting to a changing climate. The case studies are from here on referenced to as "Stó:lō case study" and "Apache case study."

In this chapter, I qualitatively compare the results of the case studies to elucidate common themes pertaining to (i) adaptation to climate change in North American Indigenous community contexts and (ii) the roles that Indigenous organizations can perform to support communities in adapting to climate change. Case study results and recommendations are further explored and detailed throughout chapters 3 and 4. I divide this chapter according to the domains that comprised the data analysis—domains are described in section 1.5.

5.1. Observed Climatic and Environmental Changes

Observed impacts are solely based on research participants' subjective observations of their territories and traditional knowledge and do not provide scientific attribution of observed impacts to global climate change. Research participants not only compare the climate and environment of their territories to their memories and knowledge of past conditions, but also trace interconnections and causal links among observed impacts, expressing knowledge of environmental and ecological dynamics pertaining to their traditional territories' environments. This study reaffirms that traditional knowledge is dynamic and that detailed observations of local environmental conditions are continuously incorporated into traditional bodies of knowledge (Berkes 2009; Gómez-Baggethun, Corbera, and Reyes-García 2013).

For the Stó:lō case study, the most referenced observed impacts are associated with the Fraser River—warmer Fraser River temperatures, lower water levels, more variable water levels, and lower water quality. Associated impacts to Fraser River salmonid populations are also prominent—decline in salmonid populations, changes in timing of salmonid returns, and diseased salmonids. For impact descriptions and interview excerpts, see section 3.1.

This is a reflection not only of documented changes to the Fraser River and its salmonid populations (Cohen 2012; Healey 2011; Jacob, McDaniels, and Hinch 2010; McDaniels et al. 2010; Martins et al. 2011; Morrison et al. 2002; Reed et al. 2011), but also of the importance of the Fraser River in Stó:lō worldview and way of life (Carlson 2001a; Schaepe 2007). The Stó:lō have inhabited the Lower Fraser River watershed since time immemorial, their connection to the Fraser River being expressed in their self-identification as people of the "river of rivers." (Carlson 2001a, 24) The relationship with Fraser River salmon is equally significant, as salmon are regarded as ancestors and traditionally comprise the most significant staple in Stó:lō diet (Cameron 1997; Deur 1999; McHalsie 2007; Smith 2001).

For the Apache case study, the most referenced impacts are related to observed local climate aridification. Although the Southwest as a region has not experienced a decrease in precipitation that can be linked to anthropogenic climate change, weather stations in Arizona show an overall decrease in annual averaged precipitation during the period 1901–2010 (Hoerling et al. 2013). Associated reported impacts include decline in snowfall, decline in rainfall, drier weather, lower river water levels, and more frequent wildfires (see section 4.1). These impacts also correlate to the effects on the tribal community that participants reported with most expressed concern—effects stemming from increase in wildfires and threats to long-term water supply.

Impacts to traditional resources emerged as a prominent theme in both case studies. For the Stó:lō case study, this primarily refers to Fraser River salmonid populations, followed by decreased availability and changes in distribution of traditional plants and medicines (e.g., wild berries, western redcedar), less healthy traditional plants, and decreased availability of local wildlife. For the Apache case study, impacts to traditional resources include decreased availability of traditional plants and medicines, decline in elk and deer populations, and less healthy elk and deer.

Participants express their understanding of certain impacts as the result of *cumulative effects*, of which global climate change is one stressor—either a scientifically attributed (Cramer et al. 2014) or a potential (suspected but not demonstrated) stressor, depending on the particular impact. Thus, this study further indicates the importance of understanding the impacts of climate change along and in interaction with other stressors, and of addressing the cumulative nature of effects in adaptation decision-making (Murray, Agbayani, and Ban 2015; Sala et al. 2000; Schindler 2001). This is especially the case for observed impacts to traditional resources. Participants consider these likely to be *partially* driven by climate change effects. That being said, changes in animal availability and behavior, changes in animal and plant phenology, and decreased traditional resource health and abundance are factors identified as climate impacts affecting North American Indigenous communities in other studies (Bennett et al. 2014; CIER 2008; Downing and Cuerrier 2011; Redsteer et al. 2013; Turner and Clifton 2009).

Still regarding impacts to traditional resources, I consider that participants in the Apache case study express causal links between global climate change and these impacts more frequently than participants in the Stó:lō case study, who seem unsure of specific drivers behind observed impacts. This may be due to Stó:lō communities being confined to multiple Indian reserves that represent a small fragment of their traditional territory (Carlson 2001b), within a region that has suffered from intense urbanization, resource development, and environmental change (Duffield 2001; Thom and Cameron 1997; Woods 2001). Where drivers for environmental change are numerous, it may be difficult to identify and isolate the contributions of specific drivers of climate change effects.

Historical changes to the lower Fraser Valley's environment are innumerable and have led to significant losses in traditional resources and use areas for Stó:lō communities (Thom and Cameron 1997). Thom and Cameron (1997) describe some of the most impactful historical processes: development of a web of roads and freeways throughout the lower Fraser Valley, BC Hydro power plants development and associated land flooding, Sumas Lake draining in the 1920s, forestry and agricultural impacts, diking of wetland and bog areas to prevent floods, and overall increased encroachment and urbanization. See Brady (2014) for a more recent analysis of resource pressure on Stó:lō traditional territory. Many of these development processes have also had

detrimental effects on Fraser River salmonids (Harper 1997). Murray Ned (pers. comm.) provides examples of cumulative effects and how they are affecting the Stó:lō:

> Sumas Lake . . . was emptied in 1924. . . . We lost major salmon species, we lost major waterfowl and birds and the game that relied on the lake as well. . . . The Chilliwack River was diverted. . . . It is pretty hard to institute mitigative measures when the harm is so severe. . . . There are numerous creeks and tributaries that I used to fish in as a kid that no longer have trout, no longer have salmon.

In summary, perceived impacts differ significantly between case studies, with the exception of (i) decline in snowfall, (ii) lower river water levels, (iii) lower water quality, (iv) various impacts to traditional resources, and (v) less predictable weather. Wildfires and floods are also mentioned in both case studies, but in different ways. Increased *frequency* of wildfires and floods are reported in the Apache case study. Fewer participants in the Stó:lō case study report perceptions of increased *risk* of wildfire and floods. Both case studies are similar in that the most referenced perceived impacts are connected to either culturally important elements or to current sources of concern for the communities. This suggests that climatic and environmental observations are guided just as much by measurable biophysical changes as by observer subjectivity.

5.2. Reported Cumulative Effects on Communities

As mentioned in the previous section, observed impacts to traditional resources comprise one of the similarities between the two case studies. This study indicates that impacts to traditional resources can exert myriad effects on Indigenous communities, including on the following dimensions: cultural practices and cultural identity, food security, health, spiritual connections, and traditional knowledge transfer. I also discuss effects of increased extreme weather events in this section.

Cultural practices and cultural identity

Participants express that diminished resource availability and health, as well as changes in resource seasonal patterns and distribution, are (further) restricting access to these resources in traditional territories, and consequently hindering cultural practices. Participants express particular concern about how impacts to traditional resources might affect ceremonies that have been conducted since time immemorial. Notable examples

include the Apache Sunrise Dance Ceremony, which is dependent upon cattail pollen (Basso 1970, 67), and the Stó:lō First Salmon Ceremony, which evidently involves connecting with Fraser River salmon (McHalsie 2007, 90–91). There might not exist substitutes for these and other needed ceremonial elements, so it is unclear if and how ceremonies would be conducted if needed resources became unavailable within given territories (Carrielynn Victor, pers. comm.; CIER 2006a; Rochelle Lacapa, pers. comm.). Ceremonies are significant in maintaining cultural identities—one Apache participant deems this issue an important part of who White Mountain Apaches are "as a people." (Leeann Lacapa, pers. comm.) Therefore, it is imperative to protect local populations that comprise needed resources so that ceremonies are maintained for generations to come.

A second threat to cultural identity stems from decline in populations of resources that are themselves foundational to a people's cultural identity—Garibaldi and Turner (2004) term these cultural keystone species. Such is the case for Stó:lō people's self-identification as "fish people" (Carrielynn Victor, pers. comm.) or "salmon people" (Eddie Gardner, pers. comm.; Murray Ned, pers. comm.), following their connection with Fraser River salmon as an ancestor, among other fish species (Carlson 2001a; Harper 1997; McHalsie 2007). Disappearance of salmon from the territory is described as a "disastrous" possibility by one participant, who states that "as the salmon goes, so do we [the Stó:lō]." (Eddie Gardner, pers. comm.) The importance of protecting local populations of such "resources" or ancestors that can be understood as cultural keystone species stems from the fact that self-identification with resources is not merely symbolic, rather represents ancestral relationships that need to be maintained through time (Ernie Victor, pers. comm.).

Garibaldi and Turner (2004, 9) also posit western redcedar to be a cultural keystone species to First Nations in British Columbia. To the Stó:lō, the redcedar was originally a particularly generous ancestor named *Xepa:y*, who was transformed into the cedar tree after passing away (McHalsie 2007, 104). In discussing impacts to local western redcedar, one Stó:lō participant expresses that the trees are "stressed" and "dying from inside out," and that it is "challenging to imagine" how ceremonies would change if the cedar tree is further affected (Carrielynn Victor, pers. comm.).

Another layer of effects stems from traditional resources frequently constituting traditional food sources (CIER 2008; Garibaldi and Turner 2004). Many ceremonies include the collective sharing of traditional foods. Not being able to serve traditional foods in ceremonies and having to incorporate store-bought foods is described by one Stó:lō participant as "sad" and as "part of the tradition that is being lost." (Murray Ned, pers. comm.)

Food security

Traditional food comprises foods harvested from local environments, which are sources of significant nutritional, social, and cultural benefits (Receveur, Boulay, and Kuhnlein 1997). Traditional foods scarcity can threaten communities' food security, especially when community members are financially vulnerable to the added expense of purchasing more of their food sources (Downing and Cuerrier 2011). In the *IPCC Fifth Assessment Report (AR5)*, Porter et al. (2014, 490) cite the World Food Summit definition for food security as access to food that is sufficient and nutritious and that does not pose health risks (FAO 1996).

Food security is a concern for Stó:lō community members who depend on fishing for their subsistence as well as for the conduction of ceremonies. Joseph Dandurand (pers. comm.) reports that community members were "definitely seeing an impact" on food fisheries. Another participant reports the increasing need to purchase fish, which feels "strange." (Maretta Beger, pers. comm.)

For the White Mountain Apache, decline in elk and deer populations, which are relied on for subsistence hunting, is one of the factors currently threatening food security (Gwendena Lee-Gatewood, pers. comm.). Other sources of impacts to traditional Apache practices, such as restricted access to fishing due to lower river water levels, less available and healthy cattle, and less productive and more costly farming, are also affecting food security. Participants describe these impacts as largely influenced by decline in runoff and rainfall (Cline Griggs, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Leeann Lacapa, pers. comm.; Rowena Cooya, pers. comm.).

Health

Traditional food scarcity can lead to negative health effects in Indigenous communities (CIER 2006a; Downing and Cuerrier 2011). Traditional food consumption has been correlated with increased intake of micronutrients and decreased intake of sodium, fat, and sucrose when compared to market foods (Kuhnlein et al. 2004; Receveur, Boulay, and Kuhnlein 1997). Research participants attribute the spread of physical health issues within Stó:lō communities, such as obesity and diabetes, to changes in traditional food habits (Clarence Pennier, pers. comm.; Sonny McHalsie, pers. comm.). Particularly problematic is the substitution of traditional foods with consumption of *unhealthy* store-bought foods. Clarence Pennier (pers. comm.) explains that these are often more affordable than their healthier or organic counterparts. Carrielynn Victor (pers. comm.) expresses concern about what health effects might stem from a significant decrease in a traditionally main staple in Stó:lō diet—salmon (Cameron 1997; Smith 2001).

Assessing such physical health effects, however, does not encompass the whole spectrum of ways in which climate change can affect Indigenous health. It is important to consider more holistic and relational definitions that are akin to Indigenous conceptualizations of health (Donatuto, Campbell, and Gregory 2016; Jantarasami et al. 2018; Labun and Emblen 2007). Downing and Cuerrier (2011, 67) identify decreased quality of life and well-being as health impacts of climate change, with "implications for the mind, body and soul."

Engagement with research participants indicates emotional and spiritual well-being as additional dimensions of Indigenous health that are being affected by change in climate and by reduced access to traditional resources more broadly. Stó:lō participants identify the interaction with traditional resources as a significant and positive contributor to emotional well-being (Eddie Gardner, pers. comm.; Ernie Victor, pers. comm.). Conversely, when certain resources are recognized and connected with as ancestors and as relatives in the natural world, harm to these beings reduces well-being in ways analogue to witnessing harm to human relatives (Carrielynn Victor, pers. comm.).

Spiritual connections

Research participants in both case studies explain connections with other-than-human beings as reciprocal relationships that need to be maintained through time and that depend upon people's respect of these beings as equals. Such relationships are thus based on respect and reciprocity (Atleo 2011). It is through stewardship and cultural practices that the Stó:lō connect spiritually with traditional resources in a reciprocal way (McHalsie 2007, 108). When access to these practices is restricted, community members become less able to experience and maintain these spiritual connections. Threats to the conduction of ceremonies are likewise threats to spiritual connections and religious practices that are dependent on ceremony (Rochelle Lacapa, pers. comm.).

Stó:lō research participants emphasize how resources such as salmon and traditional plants are committed to the reciprocal connection and to providing for Stó:lō people, and can therefore step away from this commitment if the relationship is not reciprocal (Carrielynn Victor, pers. comm.; Eddie Gardner, pers. comm.; Ernie Victor, pers. comm.). One of the ways in which the Stó:lō express their gratitude for the salmon's provision of resources is through the annual First Salmon Ceremony (McHalsie 2007, 90–91). As explored in section 3.2, changes in timing of salmonid returns and restricted access to fishing can impede the Stó:lō from catching the actual first salmon, which might negatively affect this connection (Ernie Victor, pers. comm.).

Apache research participants emphasize the negative effects of loss of respect for nature and for its seasonal cycles. Not only natural resources, but also natural phenomena such as rainfall and seasons, possess the agency to cease their support for Apaches if they are not shown respect and gratitude (Rowena Cooya, pers. comm.; see also Basso 1996). The traditional Apache explanation for climatic change thus involves nature's reaction to Apache deviation from following rules of proper conduct with other-than-human beings (Cline Griggs, pers. comm.; Leeann Lacapa, pers. comm.). Respect of seasonal cycles for the timing of cultural practices can be equally important in maintaining spiritual relationships (Cline Griggs, pers. comm.).

The Stó:lō concept of life force (*Shxwelí*), which lies in Stó:lō people's connections with ancestors (Carlson 2009; McHalsie 2007), also relates to this theme (see section 3.2). If these connections are hindered, Stó:lō people's *Shxwelí* may be

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affected. Sonny McHalsie (pers. comm.) explains how the connection to family line ancestors through stewardship of their traditional use areas is crucial for Stó:lō people's *Shxwelí*. Hence, restrictions in access to fishing and to ancestral fishing grounds can significantly affect community members' connections and own life force.

Sonny McHalsie (pers. comm.) also expresses a correlation between traditional foods scarcity and restrictions to spiritual connections. Burning of traditional foods in constitutes a means to feed ancestor spirits. The foods that feed ancestors must also share connections with them—Sonny McHalsie (pers. comm.) refers to the burning of sturgeon in his community, because they "come from the sturgeon, or close relation to the sturgeon."

Traditional knowledge transfer

As climatic changes decrease access to cultural practices, it becomes more difficult to teach these practices to younger generations. Given that traditional knowledge often needs to be experienced, decreased access to cultural practices directly affects traditional knowledge transfer associated with such practices (CIER 2006a; Turner and Spalding 2013). This comprises a long-term threat to traditional knowledge.

Stó:lō research participants note that, as fishing becomes increasingly restricted in the territory, it has become more difficult to interest younger generations in fishing and to teach Stó:lō fishing practices. Some participants question whether future generations might eventually lose these practices (Joseph Dandurand, pers. comm.; Murray Ned, pers. comm.). It is difficult to fathom the repercussions of loss of fishing and related traditional knowledge for a people that have been fishers and that have been connected to the Fraser River since time immemorial (Cameron 1997; Harper 1997; McHalsie 2007).

Seasonal patterns are also relevant to cultural practices, and their shifts can be disruptive in various ways. Changes in phenology can hinder community members' access to traditional resources, when plants and animals' seasonal patterns become less predictable and more difficult to follow (Downing and Cuerrier 2011). Additionally, Indigenous ceremonies are often connected to seasonal patterns and indicators—as these seasonal patterns shift, the timing of ceremonies become increasingly

disconnected to Indigenous calendars and associated traditional knowledge (Carrielynn Victor, pers. comm.). One Apache participant mentions the disconnection between ceremonies and seasonal cycles as a factor that is "confusing mother nature" and leading to climatic changes (Cline Griggs, pers. comm.).

It is important to note that loss of traditional knowledge is not only a detriment to Indigenous communities, but also to the pool of collective knowledge that societies can draw from to cope with novel challenges, including climate change (Berkes 2012; Turner and Spalding 2013). Therefore, protection of Indigenous traditional practices and resources is imperative to the maintenance of contemporary society's cultural and epistemic diversity (Garibaldi and Turner 2004).

Extreme weather events

Impacts of increase in extreme weather events comprise yet another relevant theme surrounding climate change effects to North American Indigenous communities (Bennett et al. 2014; CIER 2008; Redsteer et al. 2013). Impacts of extreme weather events are reported by participants in both case studies, especially in the Apache case study. Increase in wildfire events has exerted effects on the tribal community's cultural practices, tourism, recreation, and economic development (Cheryl Pailzote, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Krista Beazley, pers. comm.; Shannon Tsosie, pers. comm.). Financial losses to the Tribe include sawmill closures following the Rodeo-Chediski fire (Keller 2005). Repeated evacuations on the Tribe and the seasonal risk of having to submit to such evacuations are experienced by tribal members as a source of fear and anxiety, and as a threat to their personal safety (Alexis, pers. comm.; Gwendena Lee-Gatewood, pers. comm.).

The increase in wildfire risk to the Tribe's Wilderness area is a critical issue. This portion of the Tribe is sacred to the White Mountain Apache (Angel, pers. comm.). It also provides habitat for traditional plants and medicines, including resources needed for ceremonies (Rochelle Lacapa, pers. comm.). Furthermore, the area comprises an important source of tribal water supply (Cheryl Pailzote, pers. comm.). Participants express their concern that, due to increased risk of wildfires and lack of forest management in the area, a wildfire might significantly affect this area in the future, with

detrimental effects to long-term water supply (Cheryl Pailzote, pers. comm.; Gwendena Lee-Gatewood, pers. comm.).

Participants in the Stó:lō case study also report effects stemming from increase in extreme weather events, but these are not as prominent. Reduced air quality following wildfires in British Columbia and associated effects on health and cultural practices are reported (Shana Roberts, pers. comm.), but are not among the most emphasized themes. Increase in ice storms and associated power outages in communities are also mentioned by participants (Carrielynn Victor, pers. comm.; Taylor, pers. comm.). I speculate that the reason for lack of emphasis on wildfire effects is the timing of data collection, which was mostly conducted prior to the BC wildfire seasons of 2017 and 2018 (see section 3.2).

5.3. Identified Adaptation Actions

Identified adaptations in the Stó:lō case study include intra- and intercommunity efforts to manage and protect Fraser River salmon, and to engage in flood management and in adaptation planning. Adaptations in the Apache case study include tribal wildfire preparedness and forest management, long-term water supply planning, and economic development diversification. On an individual level, community members indicate that they are adapting their cultural practices to environmental changes in both case studies. However, this study indicates a lack of community-level efforts to mitigate or adapt to decreased availability of traditional resources and foods, with the exception of Stó:lō actions towards mitigating harm to Fraser River salmonids. For detailed information on each case study, refer to sections 3.3 and 4.3.

As discussed in section 1.1, there is literature on adaptation to climate change that distinguishes between shorter-term responses to climatic changes—coping mechanisms (Berkes and Jolly 2002) and associated coping ability (Smit and Wandel 2006) or capacity of response (Gallopín 2006)—and longer-term adaptations or adaptive strategies (Berkes and Jolly 2002) as expressions of adaptive capacity. The former would refer to responsive reactions that do not fundamentally alter a given system's adaptive capacity, while the latter represent longer-term, sustainable adaptations, that enhance overall adaptive capacity.

I choose not to apply this distinction to categorize identified adaptations. I deem that responsive adaptations, such as interpersonal food security networks and community members adjusting their cultural practices to follow environmental changes, could ultimately exert unforeseen positive consequences for adaptive capacity. For example, such responsive adjustments can lead to greater understanding of environmental changes and consequent development of actions to mitigate harm to local environments and populations.

Moreover, this form of responsive adaptation that is based on adjusting oneself to one's local environment promotes connection to nature and its resources. One Stó:lō research participant, Ernie Victor, provides a unique perspective on adaptation to climate change as an *opportunity* to be attentive to the natural environment and to follow natural cycles and changes more closely, in lieu of contemporary attempts to predict and control the natural environment, which might ultimately become ineffective given the uncertainty and rate of climatic and environmental changes currently faced (Ernie Victor, pers. comm.; see section 3.5). Following this reasoning, which is aligned with Stó:lō worldview, so-called responsive adaptations or coping mechanisms (e.g., dislocating farther in the territory to find traditional resources) might ultimately prove themselves more conducive to adaptive capacity than planned adaptations (e.g., developing a greenhouse for traditional plants).

This is also related to different conceptions of time in Stó:lō and Western worldviews. Whereas Western worldview understands time as a linear phenomenon (i.e., adaptation as planning for the future), in Stó:lō worldview it is understood cyclically (i.e., adaptation as following natural cycles):

> Everything is in cycles in our world. . . . In our culture, there is no past, present, or future, it is all together, so we don't have time. . . . . When you say change, it is a concept that produces sometimes good things for the future, sometimes bad things for the future. But in our worldview, the moment is right now. So it is what it is. You do what is in front of you. The best leaders are the ones that can follow the best. That is a whole different worldview than "the best leaders are the ones that can see the change and can rally up and make that change not happen." (Ernie Victor, pers. comm.)

At the same time, when addressing climate change, the Stó:lō are particularly aware of *Tómiyeqw*, meaning "seven generations behind and seven generations ahead." (Eddie Gardner, pers. comm.) This concept signifies Stó:lō connection and responsibility

to relatives seven generations past and forward. It implies a "higher consciousness" of how one's conduct, words, and behaviours may affect seven generations ahead (Eddie Gardner, pers. comm.).

In conclusion, I do not apply the theoretical distinction between coping mechanisms and adaptive strategies since it contradicts participants' perceptions of their adaptation efforts. I deem it useful, however, to distinguish those adaptations that are presently or potentially maladaptive. Maladaptation is defined in the *IPCC Fifth Assessment Report (AR5)* as actions or inaction that may increase the risk of negative climate effects, increase vulnerability to climate change, or lower well-being (Noble et al. 2014). Maladaptive adaptations thus hold a distinct potential to *decrease* a given system's adaptive capacity and lead to lower adaptation pathways.

Coping with traditional food scarcity by relying on store-bought food sources would be one example of maladaptation in this study. The case studies and literature point that, although this is often needed, it can result in negative health and financial effects for community members (CIER 2006a; Downing and Cuerrier 2011). Additionally, it can further disconnect community members from engaging in traditional subsistence practices, which form an integral part of cultural practice. Given that promotion of Indigenous culture was described as an adaptation opportunity in both case studies, I additionally propose that any adaptation that significantly disconnects Indigenous communities from their traditional environments and practices is potentially maladaptive, albeit sometimes unavoidable.

5.4. Adaptation Opportunities

Adaptation opportunities seem to be relatively specific to the different contexts of each community, as there is little similarity between the two case studies in this regard. Adaptation opportunities are understood in this study as adaptation enablers (Klein et al. 2014), and are largely related to elements that are decreasing community adaptive capacity, wherein opportunity is associated with changes that can overcome these elements and enhance adaptive capacity.

Stó:lō research participants emphasize promotion of cooperation within the collective Stó:lō community, promotion of Stó:lō culture and connections, and Aboriginal

rights and title recognition as needed elements for adaptive capacity (see section 3.4). These elements relate to the current British Columbian context of Stó:lō fragmentation into numerous Indian Bands and reserves which comprise a small fraction of original territory (Carlson 2001b), with the land issue still being disputed given historical lack of treaty-making (Carlson 1997a), and consultation processes not being consistently perceived as meaningful (Baker and McLelland 2003; Booth and Skelton 2011; Marsden 2005).

Apache research participants stress the need for localized climate education, promotion of Apache culture, and economic development—especially development that propels youth health and well-being—in order to effectively adapt to a changing climate. These elements relate to identified factors increasing tribal vulnerability, most prominently lack of climate awareness, recent decrease in governmental funding, and high unemployment rates and associated socioeconomic problems that negatively affect the tribal community, with particular negative effects on youth development (see section 4.4).

I delve into the identified adaptation opportunity that is applicable to both case studies: promotion of Indigenous culture. I deem that overlap on this adaptation opportunity indicates that other Indigenous communities are also likely to benefit and increase community adaptive capacity through actions geared towards the revitalization and perpetuation of their cultural practices and traditions.

Promotion of Indigenous culture

Many research participants emphasize the negative effects that colonialism has had on their communities and that are experienced to this day by community members. Full consideration of communities' colonial pasts and presents extends the study scope; hence, this topic is only addressed as it relates to adaptive capacity in participants' responses.

The Centre for Indigenous Environmental Resources and the University of British Columbia's joint research engaging with four First Nations communities across Canada led to the publication of a report on climate risks and adaptive capacity (Sydneysmith and Matthews 2011). This report partially attributes disconnection to traditional ways of

life, cultural practices, and traditional knowledge to the residential school system and its effects. However, it also indicates that this disconnection is widening as younger generations become more integrated into Western culture and technology (Sydneysmith and Matthews 2011). This is similar to the White Mountain Apache context, as intergenerational gaps and loss of Apache ways are concerning a portion of tribal members (Welch and Riley 2001). Sydneysmith and Matthews (2011) conclude that, as cultural erosion lowers community resilience, social cohesion, and health, so can cultural identity and connection with the land increase community and household capacity. The authors also indicate that elders (and their traditional knowledge) comprise the "building blocks" of efforts towards adaptive capacity building (Sydneysmith and Matthews 2011, 25).

Research participants similarly indicate that promotion of Indigenous culture is paramount to boosting community adaptive capacity. Promotion of culture enhances adaptive capacity in a number of ways. Primarily, it is integral to counteracting the negative effects of colonialism and maintaining community members' cultural identities (Kirmayer et al. 2011). The theme of disconnection to one's culture and identity is emphasized by Apache participants. Some participants describe how this disconnection can negatively affect individual adaptive capacity: "If you lose your Apache identity, you don't have anything." (Angel, pers. comm.) Conversely, pride in heritage and connections to ancestors hold potential to increase community members' adaptive capacity and morale, even when facing increased individual, household, or community vulnerability (Gwendena Lee-Gatewood, pers. comm.; Karl Hoerig, pers. comm.).

Secondly, the revitalization of connections to land and resources enables community members to perceive changes in their local environments and to adapt accordingly (Ernie Victor, pers. comm.). This also supports the dissemination of traditional knowledge that can provide communities with a deeper understanding of environmental changes and spur novel adaptation solutions (Turner and Spalding 2013; Vinyeta and Lynn 2013; Williams and Hardison 2013). Connections with resources additionally hold potential to foment smaller-scale adaptation actions aimed at land and resource stewardship. Stewardship is central to reciprocity in relationships with resources and its practice can improve traditional resource health (McHalsie 2007).

Lastly, the promotion of cultural practices that connect community members to traditional territory and resources is paramount in many Indigenous worldviews to reaching climate solutions. Research on climate change perceptions suggests similarities among Indigenous and traditional peoples of widely different cultures and geographies—from Eastern Tibetan villagers to Indigenous Bolivian farmers—in understanding change in climate as a spiritual and moral phenomenon (Byg and Salick 2009), in which other-than-human agency reacts to human misconduct (Boillat and Berkes 2013; Codjoe, Owusu, and Burkett 2012).

As discussed in section 5.2, some participants also report changes to their local climate and environment as a result of lack of respect and reciprocity in relationships with other-than-human beings and in the proper following of a seasonal calendar (Carrielynn Victor, pers. comm.; Cline Griggs, pers. comm.; Eddie Gardner, pers. comm.; Rowena Cooya, pers. comm.). These reciprocal and beneficial relationships need be restored in order to repair and prevent undesired changes in nature.

 One's cultural practices and traditional knowledge can, therefore, be perceived as climate and adaptation solutions. Sydneysmith and Matthews (2011) describe how certain First Nation community members regard their traditional knowledge as the key to their personal survival in future times of severe climate effects. This perception of one's traditional practices and knowledge as an *advantage* amidst challenging times is also expressed by participants in this study (Carrielynn Victor, pers. comm.; Gwendena Lee-Gatewood, pers. comm.; Rowena Cooya, pers. comm.). As Carrielynn Victor (pers. comm.) states, people are generally dependent on the precise functioning of contemporary society and are fragile if any events should interfere with its functioning, whereas traditional knowledge holders have the necessary skills to survive off their lands. Traditional knowledge might not only be perceived as aiding one's own survival but as supporting planetary solutions—for example, the Yanomami in Brazil perceive themselves as holders of crucial knowledge for the maintenance of the planetary system (Kopenawa 2013).

Traditional knowledge is valuable in informing and guiding adaptation solutions. In spite of this, difficulties can arise when collaborating with Western knowledge systems and institutions, including issues of detrimental traditional knowledge disclosure, or traditional knowledge misappropriation and misuse (Williams and Hardison 2013).

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Promotion of Indigenous culture can also facilitate adaptation dialogues between Indigenous and non-Indigenous parties, especially cultural education that promotes understanding of Indigenous perspectives, values, and protocols.

5.5. Organizational Roles

This study indicates that the participant organizations are supporting community adaptation and fostering community adaptive capacity. Participants indicate that the organizations are supporting adaptive capacities in their respective communities through a variety of services, including education , information circulation, community integration and network, research and technical support, community development, tourism and economic development, and cultural perpetuation.

Regarding future development, the SRRMC has started to conduct adaptation planning with Stó:lō communities. It is considering expanding its roles into cumulative effects studies and mainstreaming of climate adaptation into policy development. The Foundation is focused on strengthening the supportive roles it plays for the Fort Apache site and wider tribal community, with possibilities of expanding into climate education, partnership facilitation, and climate adaptation mainstreaming into capacity creation and site policy and planning. Detailed information on organizational roles and recommendations for each case study are provided in sections 3.5, 3.6, 4.5, and 4.6.

Organizational roles and services that promote adaptive capacity are varied and context-specific. Differences between the two case studies reflect distinctions in organizational mandates and resources. The SRRMC's mandate is to support all Stó:lō First Nations in caretaking cultural and environmental resources that constitute Stó:lō heritage. It interacts with and provides services for different Stó:lō First Nations, as well as external agencies on behalf of Stó:lō communities. Its role is not decision-maker or manager but service and resource provider to the Stó:lō. The Foundation, on the other hand, serves the White Mountain Apache Tribe primarily through services provided as the Fort Apache property manager and steward. SRRMC's roles are more diverse and include research, technical services, and policy development; the Foundation's roles are tethered to Fort Apache site development, policy, and planning.

In spite of organizational differences, educational services and information dissemination, cultural perpetuation services, and cooperation facilitation emerged as adaptive capacity promoting roles in both case studies. Both case studies indicate that communities are experiencing some degree of lack of climate change awareness, disruption in cultural practices and traditional knowledge stemming from colonial histories, and lack of sufficient cooperation among community decision-makers. Engagement with participants suggests that these and other factors constraining community adaptation can be overcome through promotion of identified adaptation opportunities and organizational roles. Organizational potential to mainstream climate adaptation into capacity creation and policy development comprises another element common to both case studies.

Findings from both organizations suggest that these services and areas of action may be especially beneficial for Indigenous organizations and projects aiming at community adaptive capacity enhancement. Hence, I would recommend that Indigenous organizations interested in enhancing community adaptive capacity explore these services and actions in particular. As discussed in section 5.4, it bears repeating that Indigenous organizations might particularly benefit from investing in projects that enhance cultural perpetuation and traditional knowledge transfer and, I would add, that promote localized and culturally relevant climate education (see section 4.4).

Chapter 6.

Conclusions

This research project involved engagement with two North American Indigenous-owned organizations and conduction of semi-structured interviews with organizational representatives and community members. Research objectives included exploration of community member perceptions of climate change effects to their traditional territories, identification of ongoing adaptation actions and enablers, and development of recommendations for organizational support of community adaptive capacity enhancement.

Results indicate that community members are perceiving increase in extreme weather events, changes in water quantity and quality, reductions in long-term water and food security, and impacts to traditional resources and traditional practices as current impacts to case study communities. These impacts are perceived as being directly or partially caused by global climate change. Climate change effects to traditional resources are reported as additional stressors impacting resources that are suffering from cumulative effects.

Research participants indicate that access to traditional resources is decreasing as resource populations decline, availability in the territory lowers, and geographical distributions and seasonal patterns shift. Particular concern surrounds impacts to traditional resources that are related to as kin or that are essential for specific ceremonies. Reduced access to resources is correlated in this study with detrimental effects to cultural practices, cultural identity, and health and well-being. Reduced access to cultural practices hinders traditional knowledge transfer associated with such practices, which may comprise a long-term threat to traditional knowledge. For such reasons, it is imperative to mitigate harm to populations that comprise resources relevant to Indigenous groups (Garibaldi and Turner 2004).

Impacts to traditional resources and practices are also lowering traditional food availability in the case study communities. Substitution of store-bought foods for traditional food sources often leads to less healthy diets and can threaten community members' food security, especially in contexts of financial vulnerability (CIER 2006a;

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Downing and Cuerrier 2011; Kuhnlein et al. 2004; Receveur, Boulay, and Kuhnlein 1997). Hence, this study also indicates that planning for food security and traditional foods scarcity comprise important topics for Indigenous adaptation planning.

Participants indicate a lack in awareness of climate change contribution to local effects, especially regarding effects on traditional resources and practices. These can be overshadowed by a series of more pressing issues within communities, including local socioeconomic problems, more acute and emergent climate effects (e.g., increase in extreme weather events), and other sources of impacts to traditional resources. Localized climate education that focuses on connections between global climate change and local effects to cultural practices and promotes positive change through traditional territory stewardship emerged as an advised solution (see section 4.4) (Gwendena Lee-Gatewood, pers. comm.; Leeann Lacapa, pers. comm.; Rochelle Lacapa, pers. comm.).

This study identifies diverse opportunities to enable adaptation and increase community adaptive capacity (see sections 3.4., 3.6, 4.4, and 4.6). Promotion of Indigenous culture is identified as an adaptation opportunity in both case studies and is beneficial for Indigenous community adaptive capacity at large. That being said, elements identified as adaptation enablers appear to be context-specific, as there was little overlap between case studies. Community input may be particularly valuable in identifying community-specific adaptation enablers.

Academic engagement with participant Indigenous organizations demonstrates their potential to support the communities they serve in adapting to a changing climate, as these organizations uniquely combine capacity and expertise with cultural values and community knowledge. Participants express that the organizations are presently supporting community adaptive capacity, and indicate varied possibilities to further enhance this support. Prominent services and roles that promote adaptive capacity include climate education and information dissemination, cultural perpetuation services, cumulative effects studies, direct support of communities in adaptation planning efforts, and intra- and intercommunity networking and cooperation building for adaptation dialogues. Organizational potential to boost and mobilise climate awareness and adaptation into capacity creation and policy is identified as a focus for further examination in both case studies.

These findings indicate that other Indigenous communities may also benefit from educational, cultural perpetuation, and cooperation facilitation services to enhance adaptive capacity to climatic changes. Results also demonstrate that Indigenous organizations may possess unexplored potential to mainstream climate adaptation into current activities, including capacity creation, policy development, and land use planning. This study supports the recommendation that Indigenous organizations working towards community adaptive capacity explore these services and actions.

Lastly, the case studies indicate that colonial disruptions persist to present-day Indigenous adaptive capacity; however, Indigenous organizations are performing an essential role in proactively filling capacity gaps. Climate change effects are projected to increasingly threaten traditional territories, waterways, and resources paramount to Indigenous groups' well-being and cultural continuation. Boosting Indigenous community adaptive capacity is essential to mitigate current and projected climate effects. I expect that the elements identified here may support Indigenous organizations and communities in reflecting upon and addressing their own climate impacts, adaptation needs, and adaptation actions.

References

'About the Gathering'. n.d. Coast Salish Gathering 2017. Accessed 8 May 2019.
http://www.coastsalishgathering.com/about-gathering.

Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty,
B. Smit and K. Takahashi, 2007: Assessment of adaptation practices, options,
constraints and capacity. *Climate Change 2007: Impacts, Adaptation and
Vulnerability. Contribution of Working Group II to the Fourth Assessment Report
of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani,
J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University
Press, Cambridge, UK, 717-743.

Asch, Michael, and Patrick Macklem. 1991. 'Aboriginal Rights and Canadian
Sovereignty: An Essay on R. v. Sparrow'. *Alberta Law Review* 29: 498.

Atleo, Eugene Richard. 2011. *Principles of Tsawalk: An Indigenous Approach to Global
Crisis / Umeek (E. Richard Atleo).* Vancouver: UBC Press.

Baker, Douglas C., and James N. McLelland. 2003. 'Evaluating the Effectiveness of
British Columbia's Environmental Assessment Process for First Nations'
Participation in Mining Development'. *Environmental Impact Assessment Review*
23 (5): 581–603. https://doi.org/10.1016/S0195-9255(03)00093-3.

Basso, Keith H. 1970. *The Cibecue Apache / by Keith H. Basso.* Case Studies in
Cultural Anthropology. New York: Holt, Rinehart and Winston.

———. 1996. *Wisdom Sits in Places: Landscape and Language among the Western
Apache / Keith H. Basso*. Albuquerque: University of New Mexico Press.

Bennett, T. M. B., N. G. Maynard, P. Cochran, R. Gough, K. Lynn, J. Maldonado, G.
Voggesser, S. Wotkyns, and K. Cozzetto, 2014: Ch. 12: Indigenous Peoples,
Lands, and Resources. *Climate Change Impacts in the United States: The Third
National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W.
Yohe, Eds., U.S. Global Change Research Program, 297-317.
doi:10.7930/J09G5JR1.

Bengtsson, Mariette. 2016. 'How to Plan and Perform a Qualitative Study Using Content
Analysis'. *NursingPlus Open* 2 (January): 8–14.
https://doi.org/10.1016/j.npls.2016.01.001.

Berkes, Fikret. 2009. 'Indigenous Ways of Knowing and the Study of Environmental
Change.' *Journal of the Royal Society of New Zealand* 39 (4): 151–56.

———. 2012. *Sacred Ecology / Fikret Berkes.* 3rd edition. New York: Routledge.

Berkes, Fikret, and Dyanna Jolly. 2002. 'Adapting to Climate Change: Social-Ecological Resilience in a Canadian Western Arctic Community'. *Conservation Ecology* 5 (2). https://www.jstor.org/stable/26271828.

Berkhout, Frans, Julia Hertin, and David M. Gann. 2006. 'Learning to Adapt: Organisational Adaptation to Climate Change Impacts'. *Climatic Change* 78 (1): 135–56. https://doi.org/10.1007/s10584-006-9089-3.

Biagini, Bonizella, Rosina Bierbaum, Missy Stults, Saliha Dobardzic, and Shannon M. McNeeley. 2014. 'A Typology of Adaptation Actions: A Global Look at Climate Adaptation Actions Financed through the Global Environment Facility'. *Global Environmental Change* 25 (March): 97–108. https://doi.org/10.1016/j.gloenvcha.2014.01.003.

Boillat, Sébastien, and Fikret Berkes. 2013. 'Perception and Interpretation of Climate Change among Quechua Farmers of Bolivia: Indigenous Knowledge as a Resource for Adaptive Capacity'. *Ecology and Society* 18 (4). https://doi.org/10.5751/ES-05894-180421.

Booth, Annie, and Norm W. Skelton. 2011. '"We Are Fighting for Ourselves" — First Nations' Evaluation of British Columbia and Canadian Environmental Assessment Processes'. *Journal of Environmental Assessment Policy and Management* 13 (03): 367–404. https://doi.org/10.1142/S1464333211003936.

Brady, Karen Ann. 'Bringing Visibility to the Resource Pressures on S'ólh Téméxw (Stó:lō Traditional Territory): An Analysis of Referrals from 2008.' Project MRMPlanning, Simon Fraser University, 2014. http://summit.sfu.ca/identifier/etd8393.

Bruce L Berg. 2009. *Qualitative Research Methods for the Social Sciences / Bruce L. Berg.* 7th ed. Boston: Allyn & Bacon.

Butler, Caroline F. 'Regulating Tradition: Sto:lo Wind Drying, and Aboriginal Rights.' MA thesis, University of British Columbia, 1998. http://hdl.handle.net/2429/8016

Byg, Anja, and Jan Salick. 2009. 'Local Perspectives on a Global Phenomenon— Climate Change in Eastern Tibetan Villages'. *Global Environmental Change*, Traditional Peoples and Climate Change, 19 (2): 156–66. https://doi.org/10.1016/j.gloenvcha.2009.01.010.

Cameron, Laura. 1997. 'The Aboriginal Right to Fish in Carlson, Keith, and Stó:lō Heritage Trust.' In *You Are Asked to Witness: The Stó:lō in Canada's Pacific Coast History / Edited by Keith Thor Carlson.* Chilliwack, BC: Stó:lō Heritage Trust.

Canada, Government of Canada; Indigenous and Northern Affairs. 2018. 'First Nation Adapt Program, Selected Projects 2017-2018'. Resource list. 27 March 2018. https://www.aadnc-aandc.gc.ca/eng/1522157553041/1522157576757.

Carlson, Keith. 1997a. 'A Legacy of Broken Promises: The *Xwelítem* Exploration and Settlement of *S'ólh Téméxw (Our Land)'*. In *You Are Asked to Witness: The Stó:lō in Canada's Pacific Coast History / Edited by Keith Thor Carlson.* Chilliwack, BC: Stó:lō Heritage Trust.

———. 1997b. 'Early Nineteenth Century *Stó:lō* Social Structures and Government Assimilation Policy in Carlson, Keith, and Stó:lō Heritage Trust.' In *You Are Asked to Witness: The Stó:lō in Canada's Pacific Coast History / Edited by Keith Thor Carlson.* Chilliwack, BC: Stó:lō Heritage Trust.\

———. 2001a. 'Expressions of Collective Identity.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]].* Vancouver: Douglas & McIntyre.

———. 2001b. 'Indian Reservations.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]].* Vancouver: Douglas & McIntyre.

———. 2001c. 'The Fraser River Gold Rush, 1858.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]].* Vancouver: Douglas & McIntyre.

———. 2009. *Mountains that See, and that Need to Be Seen: Aboriginal Perspectives on Degraded Visibility Associated with Air Pollution in the BC Lower Mainland and Fraser Valley.* A Traditional Knowledge Study. Prepared for Environment Canada. http://www.clearairbc.ca/visibility/Documents/Aboriginalperspectives.pdf

Cayan, D., M. Tyree, K. E. Kunkel, C. Castro, A. Gershunov, J. Barsugli, A. J. Ray, J. Overpeck, M. Anderson, J. Russell, B. Rajagopalan, I. Rangwala, and P. Duffy. 2013. "Future Climate: Projected Average." In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 101–125. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

CIER (Centre for Indigenous Environmental Resources). 2006a. *How Climate Change Uniquely Impacts the Physical, Social and Cultural Aspects of First Nations*. Report 2. Prepared for The Assembly of First Nations. https://www.afn.ca/uploads/files/env/report_2_cc_uniquely_impacts_physical_social_and_cultural_aspects_final_001.pdf.

———. 2006b. Impacts of Climate Change on First Nation Economies. Prepared for The Assembly of First Nations. http://www.yourcier.org/impacts-of-climate-change-on-first-nation-economies.html.

———. 2008. *Climate Change and First Nations South of 60: Impacts, Adaptation, and Priorities*. Full Report. Submitted to Indian and Northern Affairs Canada. http://www.yourcier.org/climate-change-and-first-nations-south-of-60-impacts-adaptation-and-priorities-2007.html.

Cho, Ji, and Eun-Hee Lee. 2014. 'Reducing Confusion about Grounded Theory and Qualitative Content Analysis: Similarities and Differences'. *The Qualitative Report* 19 (32): 1–20.

Clarke Murray, Cathryn, Selina Agbayani, and Natalie C. Ban. 2015. 'Cumulative Effects of Planned Industrial Development and Climate Change on Marine Ecosystems'. *Global Ecology and Conservation* 4 (July): 110–16. https://doi.org/10.1016/j.gecco.2015.06.003.

Codjoe, Samuel Nii Ardey, George Owusu, and Virginia Burkett. 2014. 'Perception, Experience, and Indigenous Knowledge of Climate Change and Variability: The Case of Accra, a Sub-Saharan African City'. *Regional Environmental Change* 14 (1): 369–83. https://doi.org/10.1007/s10113-013-0500-0.

Cohen, Bruce I. 2012. *The Uncertain Future of Fraser River Sockeye, Volume 2: Causes of the Decline*. Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River. Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River. http://deslibris.ca/ID/235289.

Cramer, W., G.W. Yohe, M. Auffhammer, C. Huggel, U. Molau, M.A.F. da Silva Dias, A. Solow, D.A. Stone, and L. Tibig, 2014: Detection and attribution of observed impacts. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 979-1037.

Delgamuukw v. British Columbia, [1997] 3 S.C.R. 1010.

Deur, Douglas. 1999. 'Salmon, Sedentism, and Cultivation. Toward an Environmental Prehistory of the Northwest Coast.' In *Northwest Lands, Northwest People, Readings in Environmental History*, edited by Dale Goble, and Paul Hirt, 129–155. Seattle: University of Washington Press.

DFO (Fisheries and Oceans Canada). 2013. 'Communal Fishing Licences'. 6 September 2013. https://www.pac.dfo-mpo.gc.ca/abor-autoc/licences-permis-eng.html

———. 2014. 'Management of Fraser River Sockeye Fisheries'. 1 August 2014. https://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/sock_mgmt-gest_smonrouge-eng.html

Diethelm, Pascal, and Martin McKee. 2009. 'Denialism: What Is It and How Should Scientists Respond?' *European Journal of Public Health* 19 (1): 2–4. https://doi.org/10.1093/eurpub/ckn139.

DOI (U.S. Department of the Interior). 2013. 'Secretary Jewell Signs Historic Water Rights Agreement with White Mountain Apache Tribe and State of Arizona'. 30 July 2013. https://www.doi.gov/news/pressreleases/secretary-jewell-signs-historic-water-rights-agreement-with-white-mountain-apache-tribe-and-state-of-arizona.

Donatuto, Jamie, Larry Campbell, and Robin Gregory. 2016. 'Developing Responsive Indicators of Indigenous Community Health'. *International Journal of Environmental Research and Public Health* 13 (9): 899. https://doi.org/10.3390/ijerph13090899.

Dovers, S. 2009. 'Normalizing Adaptation.' *Global Environmental Change* 19 (1): 4–6.

Downing, Ashleigh, and Alain Cuerrier. 2011. 'A Synthesis of the Impacts of Climate Change on the First Nations and Inuit of Canada'. *IJTK Vol.10(1) [January 2011]*, January. http://nopr.niscair.res.in/handle/123456789/11066.

Duffield, Colin. 2001. 'Constructing a Province, Clear-Cutting a Nation.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]].* Vancouver: Douglas & McIntyre.

Elo, Satu, and Helvi Kyngäs. 2008. 'The Qualitative Content Analysis Process'. *Journal of Advanced Nursing* 62 (1): 107–15. https://doi.org/10.1111/j.1365-2648.2007.04569.x.

FAO (Food and Agriculture Organization of the United Nations). 1996. 'World Food Summit - Final Report - Part 1'. 13–17 November 1996. http://www.fao.org/3/w3548e/w3548e00.htm.

FBC (Fraser Basin Council). n.d. 'Fraser Basin Council - Lower Mainland Flood Management Strategy'. Accessed 8 May 2019. https://www.fraserbasin.bc.ca/water_flood.html.

Fleishman, E., J. Belnap, N. Cobb, C. A. F. Enquist, K. Ford, G. MacDonald, M. Pellant, T. Schoennagel, L. M. Schmit, M. Schwartz, S. van Drunick, A. L. Westerling, A. Keyser, and R. Lucas. 2013. "Natural Ecosystems." In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 148–167. A report by the Southwest Climate Alliance. *Washington, DC: Island Press.*

Füssel, Hans-Martin, and Richard J. T. Klein. 2006. 'Climate Change Vulnerability Assessments: An Evolution of Conceptual Thinking'. *Climatic Change* 75 (3): 301–29. https://doi.org/10.1007/s10584-006-0329-3.

Füssel, H.-M. 2007. 'Adaptation Planning for Climate Change: Concepts, Assessment Approaches, and Key Lessons'. *Sustainability Science* 2 (2): 265–75. https://doi.org/10.1007/s11625-007-0032-y.

Gallopín, Gilberto C. 2006. 'Linkages between Vulnerability, Resilience, and Adaptive Capacity'. *Global Environmental Change*, Resilience, Vulnerability, and Adaptation: A Cross-Cutting Theme of the International Human Dimensions Programme on Global Environmental Change, 16 (3): 293–303. https://doi.org/10.1016/j.gloenvcha.2006.02.004.

Garibaldi, Ann, and Nancy Turner. 2004. 'Cultural Keystone Species: Implications for Ecological Conservation and Restoration'. *Ecology and Society* 9 (3). https://doi.org/10.5751/ES-00669-090301.

Gelt, Joe. 2009. 'Apache Water Rights Settlement Worked Out'. *Arizona Water Resource*

1 (1): 1–12. Water Resources Research Center, Tucson, AZ.

Gómez-Baggethun, Erik, Esteve Corbera, and Victoria Reyes-García. 2013. 'Traditional Ecological Knowledge and Global Environmental Change: Research Findings and Policy Implications'. *Ecology and Society : A Journal of Integrative Science for Resilience and Sustainability* 18 (4). https://doi.org/10.5751/ES-06288-180472.

Haida Nation v. British Columbia (Minister of Forests), [2004] 3 S.C.R. 511, 2004 SCC 73.

Hardy, Kim, and Karen Peachey. 2015. *Learning from indigenous non-governmental organizations: A case study of three indigenous non-governmental organizations in Canada with transformative impact on their communities*. Ottawa, Ontario: Canadian Electronic Library.

Harper, Vince. 1997. 'Salmon and Aboriginal Fishing on the Lower Fraser River: Present Day Management Issues, Concerns, and Impacts.' In *You Are Asked to Witness: The Stó:lō in Canada's Pacific Coast History / Edited by Keith Thor Carlson.* Chilliwack, BC: Stó:lō Heritage Trust.

Healey, Michael. 2011. 'The Cumulative Impacts of Climate Change on Fraser River Sockeye Salmon (Oncorhynchus Nerka) and Implications for Management'. *Canadian Journal of Fisheries and Aquatic Sciences* 68 (4): 718–37. https://doi.org/10.1139/f2011-010.

Hoerling, M. P., M. Dettinger, K. Wolter, J. Lukas, J. Eischeid, R. Nemani, B. Liebmann, and K. E. Kunkel. 2013. "Present Weather and Climate: Evolving Conditions." In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 74–100. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

House Republicans. n.d. 'H.R. 1065: White Mountain Apache Tribe Water Rights Quantification Act of 2009'. n.d. *Gop.Gov* (blog). Accessed 3 May 2019. https://www.gop.gov/bill/h-r-1065-white-mountain-apache-tribe-water-rights-quantification-act-of-2009/.

Hsieh, Hsiu-Fang, and Sarah E. Shannon. 2005. 'Three Approaches to Qualitative Content Analysis'. *Qualitative Health Research* 15 (9): 1277–88. https://doi.org/10.1177/1049732305276687.

IPCC, 2014: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Isaac, Thomas, and Anthony Knox. 2003. 'The Crown's Duty to Consult Aboriginal People'. *Alberta Law Review* 41: 49.

Jacob, Colleen, Tim McDaniels, and Scott Hinch. 2010. 'Indigenous Culture and Adaptation to Climate Change: Sockeye Salmon and the St'át'imc People'. *Mitigation and Adaptation Strategies for Global Change* 15 (8): 859–76. https://doi.org/10.1007/s11027-010-9244-z.

Jones, R.N., A. Patwardhan, S.J. Cohen, S. Dessai, A. Lammel, R.J. Lempert, M.M.Q. Mirza, and H. von Storch, 2014: Foundations for decision making. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 195-228.

Keller, P. 2005. 'Arizona's Rodeo-Chediski Fire: A Forest Health Problem'. *Fire Management Today*. 65 (1): 7–10.

Kenward, Alyson, Todd Sanford, and James Bronzan. 2016. *Western Wildfires: A Fiery Future*. Climate Central. https://www.climatecentral.org/news/western-wildfires-climate-change-20475.

Kirchmeier-Young, M. C., N. P. Gillett, F. W. Zwiers, A. J. Cannon, and F. S. Anslow. 2019. 'Attribution of the Influence of Human-Induced Climate Change on an Extreme Fire Season'. *Earth's Future* 7 (1): 2–10. https://doi.org/10.1029/2018EF001050.

Kirmayer, Laurence J, Stéphane Dandeneau, Elizabeth Marshall, Morgan Kahentonni Phillips, and Karla Jessen Williamson. 2011. 'Rethinking Resilience from Indigenous Perspectives'. *The Canadian Journal of Psychiatry* 56 (2): 84–91. https://doi.org/10.1177/070674371105600203.

Klein, R.J.T., G.F. Midgley, B.L. Preston, M. Alam, F.G.H. Berkhout, K. Dow, and M.R. Shaw, 2014: Adaptation opportunities, constraints, and limits. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 899-943.

Kopenawa, Davi. 2013. *The Falling Sky: Words of a Yanomami Shaman / Davi Kopenawa, Bruce Albert ; Translated by Nicholas Elliott and Alison Dundy.* Cambridge, Masschusetts: The Belknap Press of Harvard University Press. http://dx.doi.org/10.4159/harvard.9780674726116.

Kovach, Margaret. 2009. *Indigenous Methodologies: Characteristics, Conversations and Contexts / Margaret Kovach.* Toronto: University of Toronto Press. http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=682652.

Krippendorff, Klaus. 2004. 'Reliability in Content Analysis'. *Human Communication Research* 30 (3): 411–33. https://doi.org/10.1111/j.1468-2958.2004.tb00738.x.

Kuhnlein, H. V., O. Receveur, R. Soueida, and G. M. Egeland. 2004. 'Arctic Indigenous Peoples Experience the Nutrition Transition with Changing Dietary Patterns and Obesity'. *The Journal of Nutrition* 134 (6): 1447–53. https://doi.org/10.1093/jn/134.6.1447.

Labun, Evelyn R., and Julia Emblen. 2007. 'Health as Balance for the Stó:lo Coast Salish'. *Journal of Transcultural Nursing* 18 (3): 208–14. https://doi.org/10.1177/1043659607301298.

LFFA (Lower Fraser Fisheries Alliance). n.d. 'Climate Change Adapt'. Accessed 3 May, 2019. https://www.lffa.ca/initiatives/climate-change-adapt.

MacDonald, Kalya C. 2018. 'Crossing Paths: Knowing and Navigating Routes of Access to Stó:lō Fishing Sites.' In *Towards a New Ethnohistory: Community-Engaged Scholarship among the People of the River*, edited by Keith Thor Carlson, John Sutton Lutz, David M. Schaepe, Naxaxalhts'i Albert 'Sonny' McHalsie. Winnipeg, Manitoba: University of Manitoba Press. http://books.scholarsportal.info/en/read?id=/ebooks/ebooks3/upress/2018-09-14/1/9780887555497.

Mahaney, Nancy, and John R. Welch. 2002. 'The Legacy of Fort Apache: Interpretive Challenges at a Community Historic Site'. *Journal of the Southwest* 44 (1): 35–47.

MARR (Ministry of Aboriginal Relations and Reconciliation). n.d. 'Consulting with First Nations - Province of British Columbia'. Accessed 3 May 2019. https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations.

MARR (Ministry of Aboriginal Relations and Reconciliation). n.d. 'Strategic Engagement Agreements - Province of British Columbia'. Accessed 13 May 2019. https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations-negotiations/strategic-engagement-agreements.

Marsden, Tara. 2006. *From the Land to the Supreme Court, and Back Again: Defining Meaningful Consultation with First Nations in Northern British Columbia*. University of Northern British Columbia. https://doi.org/10.24124/2006/bpgub407.

Martins, Eduardo G., Scott G. Hinch, David A. Patterson, Merran J. Hague, Steven J. Cooke, Kristina M. Miller, Michael F. Lapointe, Karl K. English, and Anthony P. Farrell. 2011. 'Effects of River Temperature and Climate Warming on Stock-specific Survival of Adult Migrating Fraser River Sockeye Salmon (Oncorhynchus Nerka)'. *Global Change Biology* 17 (1): 99–114. https://doi.org/10.1111/j.1365-2486.2010.02241.x.

McCracken, Grant David. 1988. *The Long Interview / Grant McCracken.* Qualitative Research Methods ; v. 13. Newbury Park, Calif. ; London: SAGE. http://methods.sagepub.com/book/the-long-interview.

McDaniels, Tim, Sarah Wilmot, Michael Healey, and Scott Hinch. 2010. 'Vulnerability of Fraser River Sockeye Salmon to Climate Change: A Life Cycle Perspective Using Expert Judgments'. *Journal of Environmental Management* 91 (12): 2771–80. https://doi.org/10.1016/j.jenvman.2010.08.004.

McHalsie, Albert (Sonny), David M. Schaepe, and Keith Thor Carlson. 2001. 'Making the World Right through Transformations.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]].* Vancouver: Douglas & McIntyre.

McHalsie, Naxaxalhts'i Albert (Sonny). 2007. 'We Have to Take Care of Everything That Belongs to Us.' In *Be of Good Mind: Essays on the Coast Salish*, edited by B. G. Miller, 82–130. Vancouver: UBC Press.

Morellato, Maria. 2008. 'The Crown's Constitutional Duty to Consult and Accommodate Aboriginal and Treaty Rights'. Research Paper for the National Centre for First Nations Governance. Retrieved from http://fngovernance.org/resources_docs/Crown_Duty_to_Consult__Accommodate.pdf

Morrison, Jessica Marie. 'Stó:lō Connect : A Case Study in Collaborative First Nation Referral Management / by Jessica Marie Morrison.' Project MRMPlanning, Simon Fraser University, 2013. http://summit.sfu.ca/identifier/etd8101.

Morrison, John, Michael C Quick, and Michael G. G Foreman. 2002. 'Climate Change in the Fraser River Watershed: Flow and Temperature Projections'. *Journal of Hydrology* 263 (1): 230–44. https://doi.org/10.1016/S0022-1694(02)00065-3.

Noble, I.R., S. Huq, Y.A. Anokhin, J. Carmin, D. Goudou, F.P. Lansigan, B. Osman-Elasha, and A. Villamizar, 2014: Adaptation needs and options. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 833-868.

NVivo qualitative data analysis software; QSR International Pty Ltd. Version 12, 2018.

Plant, Byron. 2002. *"In Principle": Sto:lo Political Organizations and Attitudes Towards Treaty Since 1969*. Stó:lō Ethnohistory Field School Paper. Document on file with the Stó:lō Nation Archives in Chilliwack, British Columbia.

Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso, 2014: Food security and food production systems. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 485-533.

R. v. Sparrow, [1990] 1 SCR 1075.

Receveur, O., M. Boulay, and H. V. Kuhnlein. 1997. 'Decreasing Traditional Food Use Affects Diet Quality for Adult Dene/Métis in 16 Communities of the Canadian Northwest Territories'. *The Journal of Nutrition* 127 (11): 2179–86. https://doi.org/10.1093/jn/127.11.2179.

Redsteer, M. H., K. Bemis, K. Chief, M. Gautam, B. R. Middleton, and R. Tsosie. 2013. "Unique Challenges Facing Southwestern Tribes." In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 385–404. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Reed, Thomas E., Daniel E. Schindler, Merran J. Hague, David A. Patterson, Eli Meir, Robin S. Waples, and Scott G. Hinch. 2011. 'Time to Evolve? Potential Evolutionary Responses of Fraser River Sockeye Salmon to Climate Change and Effects on Persistence'. *PLOS ONE* 6 (6): e20380. https://doi.org/10.1371/journal.pone.0020380.

Sala, Osvaldo E., F. Stuart Chapin, Iii, Juan J. Armesto, Eric Berlow, Janine Bloomfield, Rodolfo Dirzo, et al. 2000. 'Global Biodiversity Scenarios for the Year 2100'. *Science* 287 (5459): 1770–74. https://doi.org/10.1126/science.287.5459.1770.

Schaepe, D. M. 2007. 'Stó:lō Cultural Identity and the Cultural Landscape of S'ólh Téméxw.' In *Be of Good Mind: Essays on the Coast Salish*, edited by B. G. Miller, 234–259. Vancouver: UBC Press.

———. 2009. 'Pre-Colonial Sto:lo-Coast Salish Community Organization : An Archaeological Study'. University of British Columbia. https://doi.org/10.14288/1.0058411.

Schindler, D W. 2001. 'The Cumulative Effects of Climate Warming and Other Human Stresses on Canadian Freshwaters in the New Millennium'. *Canadian Journal of Fisheries and Aquatic Sciences* 58 (1): 18–29. https://doi.org/10.1139/f00-179.

Sydneysmith, Robin, and Ralph Matthews. 2011. 'Primary Case Study Analysis.' In CIER and UBC. *Climate Change and Adaptive Capacity in Aboriginal Communities South of 60 Assessment Report*. CIER (Centre for Indigenous Environmental Resources) and UBC (University of British Columbia). Submitted to Indian and Northern Affairs Canada (INAC). http://www.yourcier.org/climate-change-and-adaptive-capacity-in-aboriginal-communities-south-of-60-assessment-report-2011.html.

Smit, B., I. Burton, R.J.T. Klein, and R. Street. 1999. 'The Science of Adaptation: A Framework for Assessment'. *Mitigation and Adaptation Strategies for Global Change* 4 (3): 199–213. https://doi.org/10.1023/A:1009652531101.

Smit, B., Pilifosova, O. 2001. Adaptation to Climate Change in the Context of Sustainable Development and Equity. Chapter 18 in *Climate Change 2001: Impacts, Adaptation, and Vulnerability— Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK.

Smit, Barry, and Johanna Wandel. 2006. 'Adaptation, Adaptive Capacity and Vulnerability'. *Global Environmental Change*, Resilience, Vulnerability, and Adaptation: A Cross-Cutting Theme of the International Human Dimensions Programme on Global Environmental Change, 16 (3): 282–92. https://doi.org/10.1016/j.gloenvcha.2006.03.008.

Smith, David A. 2001. 'Salmon Populations and the Stó:lo Fishery.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]]*. Vancouver: Douglas & McIntyre.

SRRMC (Stó:lō Research and Resource Management Centre). 2014. *S'ólh Téméxw Use Plan Policy*. Document on file with the Stó:lō Nation Archives in Chilliwack, British Columbia.

Stó:lō First Nations and the Province of British Columbia. 2016. *Strategic Engagement Agreement Between Stó:lō First Nations and British Columbia*. Document on file with the Stó:lō Nation Archives in Chilliwack, British Columbia.

Stó:lō Nation. 2003a. *Stó:lō Heritage Policy Manual*. Document on file with the Stó:lō Nation Archives in Chilliwack, British Columbia.

———. 2003b. *Stó:lō Heritage Resource Management Plan*. Document on file with the Stó:lō Nation Archives in Chilliwack, British Columbia.

———. n.d. 'Sto:lo Resource and Research Management'. Accessed 10 May 2019. http://www.srrmcentre.com/.

Stó:lō Tribal Council. n.d. 'Who Are We? | Stó:lō Tribal Council'. Accessed 21 May 2019. http://stolotribalcouncil.ca/about-us/who-are-we/.

SXTA (Stó:lō Xwexwilmexw Treaty Association). n.d. 'SXTA Communities – Stó:lō Xwexwilmexw Treaty Association'. Accessed 3 May, 2019. http://sxta.bc.ca/sxta-communities/.

Tennant, Paul. 1990. *Aboriginal Peoples and Politics: The Indian Land Question in British Columbia, 1849-1989*. Vancouver, CA: UBC Press.

The Constitution Act, 1982, Schedule B to the Canada Act 1982 (UK), 1982, c 11. http://canlii.ca/t/ldsx.

Thom, Brian, and Laura Cameron. 1997. 'Changing Land Use in *S'ólh Téméxw* (Our Land): Population, Transportation, Ecology and Heritage.' In *You Are Asked to Witness: The Stó:lō in Canada's Pacific Coast History / Edited by Keith Thor Carlson.* Chilliwack, BC: Stó:lō Heritage Trust.

Turner, Nancy J., and Helen Clifton. 2009. '"It's so Different Today": Climate Change and Indigenous Lifeways in British Columbia, Canada'. *Global Environmental Change*, Traditional Peoples and Climate Change, 19 (2): 180–90. https://doi.org/10.1016/j.gloenvcha.2009.01.005.

Turner, Nancy, and Pamela Spalding. 2013. '"We Might Go Back to This"; Drawing on the Past to Meet the Future in Northwestern North American Indigenous Communities'. *Ecology and Society* 18 (4). https://doi.org/10.5751/ES-05981-180429.

UN General Assembly. 2007. *United Nations Declaration on the Rights of Indigenous Peoples: resolution / adopted by the General Assembly*, 2 October 2007, A/RES/61/295. https://www.refworld.org/docid/471355a82.html.

USDA (U.S. Department of Agriculture). n.d. 'Apache-Sitgreaves National Forests - History & Culture'. Accessed 3 May, 2019. https://www.fs.usda.gov/detail/asnf/learning/history-culture/?cid=fsbdev7_012567.

Vinyeta, Kirsten, and Kathy Lynn. 2013. *Exploring the role of traditional ecological knowledge in climate change initiatives*. Gen. Tech. Rep. PNW-GTR-879. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 37 p., 879.

Welch, John. 2009. 'Reconstructing an Ndee sense of place'. *The Archaeology of Meaningful Places*, 149–162.

Welch, J. R. 2019. 'Conserving Contested Ground: Sovereignty-Driven Stewardship by the White Mountain Apache Tribe and the Fort Apache Heritage Foundation.' *In Environmental Activism on the Ground: Small Green and Indigenous Organizing / Edited by Jonathan Clapperton and Liza Piper.* Calgary, AB: University of Calgary Press.

Welch, John R., and Robert C. Brauchli. 2010. '"Subject to the Right of the Secretary of the Interior": The White Mountain Apache Reclamation of the Fort Apache and Theodore Roosevelt School Historic District'. *Wicazo Sa Review* 25 (1): 47–73. https://doi.org/10.1353/wic.0.0057.

Welch, John R., and Ramon Riley. 2001. 'Reclaiming Land and Spirit in the Western Apache Homeland'. *The American Indian Quarterly* 25 (1): 5–12. https://doi.org/10.1353/aiq.2001.0015.

Welsh, Elaine. 2002. 'Dealing with Data: Using NVivo in the Qualitative Data Analysis Process'. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 3 (2). https://doi.org/10.17169/fqs-3.2.865.

Williams, Terry, and Preston Hardison. 2014. 'Culture, Law, Risk and Governance: Contexts of Traditional Knowledge in Climate Change Adaptation'. In *Climate Change and Indigenous Peoples in the United States: Impacts, Experiences and Actions*, edited by Julie Koppel Maldonado, Benedict Colombi, and Rajul Pandya, 23–36. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-05266-3_3.

Woods, Jody R. 2001. 'Sumas Lake Transformations.' In *A Stó:lo Coast Salish Historical Atlas / Keith Thor Carlson, Editor ; Albert (Sonny) McHalsie, Cultural Advisor ; Jan Perrier, Graphic Artist & Illustrator ; [Authors, Kate Blomfield [and Others]].* Vancouver: Douglas & McIntyre.

WMAT (White Mountain Apache Tribe). n.d. 'NdeeBikiyaa'. Accessed 3 May, 2019. http://www.wmat.nsn.us/WMAT_Farm_website/NDeeBikiyaa_home.html.

Appendix A.

Semi-structured Interview Guide

Climate change and adaptation questions

Have you noticed change in weather or in the natural environment within your traditional territory/tribal reservation over time?

Do you perceive these changes as being related to global climate change?

Would you say that climate change is currently a topic within the community?

What would you say are the most worrisome climate change effects to the community, if any?

Would you say that culturally important activities are being harmed by these changes?

Have you or people that you know been personally coping with any of these changes in any way?

Do you know of any ongoing initiatives on adaptation to climate change within the community?

What would you say are the main challenges for the community to adapt to climate change effects?

In your opinion, what changes are necessary for the community to be prepared for future obstacles, such as harmful climate change effects?

Organizational questions

Applicable to organizations' board members and staff

How would you describe this organization?

How do you see the mission, vision, and values of the organization?

Who does this organization serve?

What is the organization currently involved with?

Regarding the work that the organization is currently involved with, is there anything that is touching on climate change or that has a direct link with any climate change effects?

What can you tell me about the organization's network? What are its main project partners?

Applicable to all participants

Would you say that the organization is well integrated into the community?

How do you think the organization could best support the community in preparing for climate change effects?

Appendix B.

Participant Consent Form

Who is conducting this study?
The Principal Investigator (PI) of this study is Viviane Hippmann Gauer, Master of Resource Management (MRM) candidate, School of Resource and Environmental Management at Simon Fraser University (SFU), Canada. She can be reached by phone or e-mail.

Viviane is supported by Faculty Supervisor Dr. John Welch of SFU, reachable by phone or e-mail.

This research will result in Viviane H. Gauer's graduate research project, REM 699. The finished product will be publicly available through the SFU Library. Findings may be published in journals. All interviews and analyses will be conducted by Viviane.

Why should you take part in this study?
You are being invited to participate in this research because you are affiliated with one of the participant organizations to this study, or because you are a collaborator to one of the organizations who might have relevant contributions to this research project.

The study PI will request your thoughts and opinions on: (1) adaptation to climate change in the community that you are part of; (2) institutional and organizational factors regarding the Stó:lō Research and Resource Management Centre or the Fort Apache Heritage Foundation.

The study seeks to: (1) collaboratively identify strategic interventions to boost the participant organizations' capacities to plan for climate change adaptation, to the benefit of the communities they serve; (2) advance knowledge of factors influencing organizational development of adaptation projects in North American Indigenous contexts.

Your participation is voluntary.
You have the right to refuse to participate in this study. If you decide to participate, you may still choose to withdraw from the study at any time without penalty or repercussion. You have the right to refuse to answer any questions you do not want to and are welcome to discuss any questions you may have thought of that can help to inform this study.

What happens if you say: "Yes, I want to be in the study."?

If you agree to participate in this study:

1. You will be invited to participate in an interview, and to arrange the best time and location with the PI. The interview will be conducted by Viviane and is expected to last between an hour and an hour and a half.

2. Viviane will ask you to record the interview. You can agree or not to this request. You will not be obligated to answer any questions you do not wish to. Additional questions or information that you would like to contribute with will be gladly received.
3. If further information is needed, you might be invited to additional individual or group interviews. You will be asked at the end of the interview if you consent to being contacted again in case further information is needed. Even if you consent to being contacted, you may refuse to participate at any time.
4. Viviane will be available to answer any questions you have about the research, and discuss any possible concerns.

How will the responses be recorded?
Viviane will ask your permission to record the audio of the interview using an electronic recorder. Afterwards she will transcribe the relevant sections, and then erase the audio file in order to maintain confidentiality. Interviews will be transcribed into encrypted digital documents. Viviane will be the only person with access to audio recordings and transcripts of interviews, unless you consent that your recordings and transcripts be placed in the Stó:lō Archives.

Interview responses may be referenced or quoted in Viviane's graduate research project and/or in academic journal articles. A pseudonym will be used unless you consent to disclose your identity.

Are there any risks to participating in this study?
We do not think there is anything in this study that could harm you or constitute a risk for you. You do not have to answer any questions that you do not want to or do not feel comfortable with.

What are the potential benefits of participating in this study?
You may not benefit directly by participating in this study. However, by participating, you will help advance knowledge that is expected to benefit the participant organizations and the communities they serve in preparing for climate change effects.

How will your identity be protected?
Your confidentiality will be respected. Information that discloses your identity will not be released without your consent. All study documents and data will be stored electronically on encrypted and password-protected documents. Viviane will be the only person to have access to data collection material, unless you consent that your recordings and transcripts be placed in the Stó:lō Archives.

We provide an option for your name to be associated to your research responses in the consent section of this document. If you do not want your name to be disclosed, you will be given a pseudonym in the transcription of your interview, and your name and other identifiable characteristics will not be mentioned in any reports or publications.

What level of confidentiality can you expect if you participate in a group interview?
If you are invited to and agree to participate in a group interview, only limited confidentiality can be offered. Viviane will encourage participants not to discuss the content of the group interview to people outside the group, but cannot have certainty that

they will not. Aside from this, all of the aforementioned confidentiality measures will be equally provided to protect your identity.

Will you receive any incentives to participate in this study?
No incentive will be offered to you prior to or after you consent to participate.

Who will be able to see the results of this research?
The results of this study will be reported in an SFU graduate study, and may be published in one or more journal articles. The Stó:lō Research and Resource Management Centre, the Fort Apache Heritage Foundation and the Pacific Institute for Climate Solutions will be sent copies of written outcomes. All research participants will have access to the REM699 Research Project, which will be publicly available through the SFU Library. Viviane will be reachable to discuss research outcomes and answer any questions throughout the research process, and after its completion.

How might this research be used in the future?
Relevant information resulting from this study may be used by the Stó:lō Research and Resource Management Centre and the Fort Apache Heritage Foundation as part of development of projects related to climate change adaptation, planning, implementation, and evaluation, or adaptive capacity enhancement.

Who can you contact if you have questions about the study?
If you have any questions concerning the study, its purpose or procedures, please contact Viviane H. Gauer. You can also contact Dr. John Welch.

Who can you contact if you have complaints of concerns about the study?
If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, you may contact Dr. Jeff Toward, Director, Office of Research Ethics.

<u>**Your consent and signature**</u>

Participation in the study
Taking part in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason and without any negative impact.

Your signature below indicates that you have received a copy of this consent form for your own records. Your signature also indicates that you consent to participate in this study.

_____   _____

Signature   Date MM/DD/YYYY

_____
Printed Name of the Participant signing above.

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Disclosure of identity

Your signature below indicates that you consent to have your name disclosed in the outcomes of this study (graduate research project and/or journal articles).

_____   _____
Signature   Date MM/DD/YYYY

_____
Printed Name of the Participant signing above.

Deposit in the Stó:lō Archives

Your signature below indicates that you consent that copies of your interview recording and transcript be deposited in the Stó:lō Archives to be available for further research, public listening, reading or viewing, and that portions of this interview may be used in publications, reports or on the Internet.

_____   _____
Signature   Date MM/DD/YYYY

_____
Printed Name of the Participant signing above.

Visual recording

Your signature below indicates that you consent to be photographed by the PI. Your signature grants the PI absolute and irrevocable right and unrestricted permission to use, reuse, publish, and republish for educational and research purposes in any format, location or medium at any time such photographs.

_____   _____
Signature   Date MM/DD/YYYY

_____
Printed Name of the Participant signing above.

Can we contact you for future research projects?

Would you be interested in contributing to research projects related to this or other studies in the future?

 ☐ YES   ☐ NO