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Takla Lake First Nation Climate Change Vulnerability & Risk Assessment

Prepared by:

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CPAWS
CANADIAN PARKS AND WILDERNESS SOCIETY
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List of acronyms

AANDC	Aboriginal Affairs and Northern Development Canada
BAFA	Boreal Altai Fescue Alpine
BEC	Biogeoclimatic Ecosystem Classification
BWBS	Boreal White Birch Black Spruce
CCAP	Climate Change Adaptation Program
CCCMA	Canadian Centre for Climate Modeling and Analysis
CPAWS-BC	Canadian Parks & Wilderness Society – BC Chapter
ESSF	Engelmann Spruce—Subalpine Fir
GDD	Growing Degree Days
ICH	Interior Cedar—Hemlock
IPCC	Intergovernmental Panel on Climate Change
MAP	Mean Annual Precipitation
MAT	Mean Annual Temperature
SBS	Sub-Boreal Spruce
SWB	Spruce-Willow-Birch
TUS	Traditional Use Study
TKUS	Traditional Knowledge and Use Study
TLFN	Takla Lake First Nation

1.0 Introduction & Project Background

The traditional lands of the Takla Lake First Nation (TLFN) are located in the northern interior of British Columbia. The territory lies within three major watersheds (Fraser, Peace, and the Skeena watersheds), and encompasses over 34,000 sq. km. The main community of Takla Landing is considered to be remote, located 375 km north-west of Prince George. The nearest service centre is Fort St. James, a town of approximately 2,000 people situated 170 km to the south. Prior to completion of a logging road between Fort St. James and Takla Landing, goods were brought into the community on the rail line (which is no longer operational) or by plane. Nearly one-third of the approximately 800 registered Band members reside full or part-time at Takla Landing or on smaller satellite reserves within the traditional territory.

In the last 50 years, the TLFN have experienced major environmental changes and stresses that have affected the health of their traditional territory. In the 1970s, logging roads began to open up outside access to the community and other areas in the territory to industrial and recreational uses including logging, mining, transportation (rail and roads), hunting, and trapping.

Today there are new challenges facing the community. Extreme weather events are occurring with increased frequency in the region and this, coupled with the industrial activities in the territory, have left areas vulnerable to erosion and flooding. Vast stretches of dead pine, resulting from warmer winters and the devastating pine beetle outbreak not only poses a wildfire risk but is causing run-off problems; both situations being a major concern to the TLFN people. These factors add to the already vulnerable situation the community faces to continue to access and utilize their ancestral lands and the resources and to maintain their traditional practices.

The TLFN community has already identified food security as a serious concern, as consuming a traditional diet is an important part of maintaining health for the Nation. In response to this concern, the Nation undertook a major human environmental health study (Healthy Lands, Healthy Future) to examine environmental contaminants in the territory and their relationship to health and food security. While risks to access of traditional food are impacted by climatic changes, increasing competition for these foods from outside sources is also severely affecting the community.

The TLFN people are at increasing risk to losing their ways of life and inherent knowledge as stewards of the land. Climate change poses yet another challenge to the health of the traditional territory that the community must face. Even though the health of their lands is diminishing, the Takla Lake people are maintaining their traditional values and cultural practices. They continue to rely on the land, the water and the natural resources within their territory, as these resources play an essential role in the physical and spiritual well-being, and cultural values of the people.

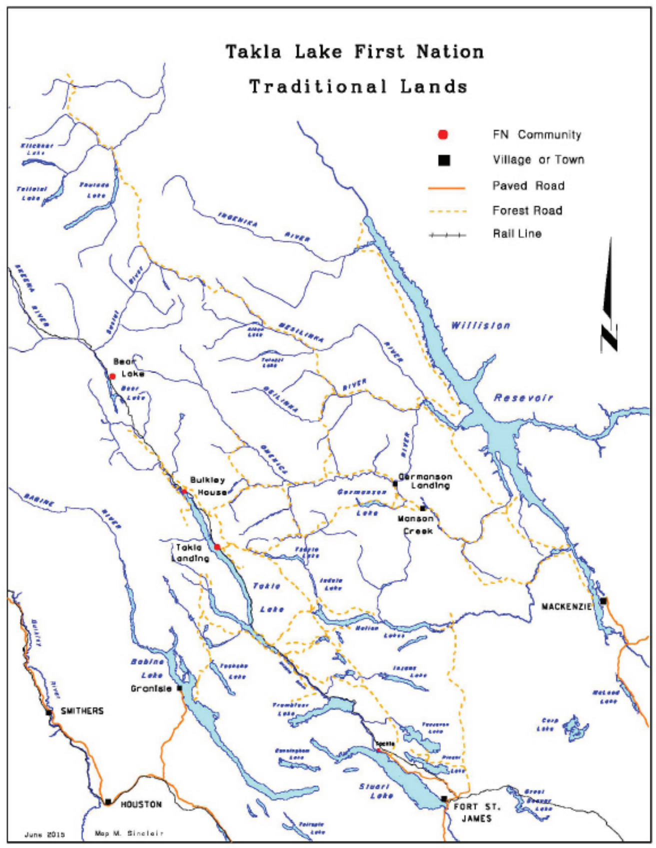

Figure 1. Takla Lake First Nation Traditional Territorial Lands

1.1 Project Significance

As a response to the environmental threats named above, the TLFN leadership and community are being proactive with their planning for the future. The potential risks associated with these environmental threats need to be understood in order to adapt and continue to enjoy a healthy environment for future generations.

While the community continues to practice a traditional way of life, it is being put in jeopardy as a result of a rapidly changing climate. This Vulnerability and Risk Assessment focuses on three specific areas that are linked to a changing climate and that threaten the health and well-being of TLFN: food security, extreme weather events, and emergency management.

While climate change and its resultant effects pose significant challenges to TLFN, the nature of these challenges and effective ways of dealing with them are not well understood by the community. Through ongoing meetings with individuals and Keyah (family) groups as part of TLFN's land use planning process, many changes to the landscape are being recorded. Areas that members have hunted or trapped in for several decades no longer provide wildlife or berries, and streams that once provided harvestable fish are no longer glacier fed and are too warm.

New figures from BC Hydro indicate that the number of power outages in Takla Landing have increased by 150% over the past four years. The limited economic opportunities available are being challenged by the devastation to the forests by the pine beetle. A resulting and escalating concern to the community and to families living on satellite reserves is the risk of wildfire.

We need to understand climate change and assess TLFN's vulnerability and resilience. This knowledge will give the community the power to be better prepared for risk reduction and adaptation to these challenges.

1.2 Project Summary and Purpose

This Vulnerability and Risk Assessment report presents the results of the first phase of a proposed three-part, long-term research project. Phase 1 identifies indicators of climate change and how to assess the indicators that are relevant for Takla Lake First Nation (TLFN) in relation to climate change. Phase 2 is to develop an adaptation plan that incorporates what was learned from the vulnerability and risk assessment (Phase 1) and come up with solutions to these vulnerabilities. Phase 3 of the project will be to develop a toolkit that can be used by other First Nations communities across Canada to assist in the development of climate change plans for their own territories. The second and third phases are funding-dependent.

The vulnerability and risk assessment project drew upon the use of locally-developed indicators to monitor and understand the impacts of climate change, in order to ensure that community members are able to readily identify changes at the local level and are able to use indicators that are relevant to their landscape and territory. This is in contrast to using generic non-local indicators which may not have relevance or significance to local communities.

Photo (above): Cutting fish.

Local TLFN experts developed the indicators to be used in partnership with CPAWS-BC. This collaboration between local and scientific experts created a strong set of parameters for analysis and success, and ensured that the community is part of the project. This also ensures the ability of Takla people to participate in the study and understand the relevance to their traditional practices and lives.

The information obtained from this project will be used to advise the TLFN on other ongoing crucial planning initiatives and understand how these will be affected by climate change. Climate change is not a separate entity to address on its own, as it affects every aspect of TLFN's social, cultural and economic well being. First Nations are on the forefront of dealing with the effects of climate change, and therefore it is vital that the results of this project be relevant to our lives. We will ensure the results of this project will inform the land use plan that is currently being developed by helping to identify and protect areas for socio-cultural, economic, and subsistence use. Watershed planning, alternative sustainable energy planning, our five-year economic development plan, and strategic community planning will all benefit from this knowledge.

1.3 Review of best practices

To ensure that the work that was undertaken was able to meet the needs of the TLFN, we developed guidelines for best practices research. For the development of the Vulnerability and Risk Assessment study, we gathered large amounts of background information from other communities' climate change planning and consulted with academics working in the climate change vulnerability and adaptation fields. By pulling from many different studies and previous climate change plans we were able to identify those aspects that were most effective and cull from our own study those practices that have been demonstrated to be less effective.

A report titled Protecting Food and Watershed Security in Light of Climate Change: A Research Base for CPAWS-BC and Takla Lake First Nation, British Columbia was completed by Maggie Low, project volunteer. This report provided baseline research for vulnerability and adaptation planning by summarizing efforts from climate change vulnerability and adaptation plans in three regions within northern B.C. and Yukon Territory (see Appendix A). Other resources and baseline research were also reviewed and summarized in this report, which provided an excellent background baseline to begin the vulnerability assessment for Takla Lake First Nation.

Sarah Ravensbergen, another project volunteer, was able to complete an online media scan of the various environmental events that have taken place on, or close to, Takla Territory since the 1960s (Appendix B: Summary of environmental events [relating to extreme weather, food security, and emergency management] occurring in the traditional territory of the Takla Lake First Nation). She narrowed down her research parameters to the three focus areas of the project: food security, emergency management and extreme weather. The information that was gathered through this online scan provided both background information for the project team and also highlighted additional vulnerabilities that were not previously identified during the Keyah[1] meetings and community member interviews.

Other areas of collaboration and review assisted in the development of the best practices approach undertaken for this study. We collaborated with Lacia Kinnear and other researchers from the Northern Climate ExChange (NCE) of Yukon College Research Centre, reviewing climate change adaptation plans developed in various regions of Yukon Territory by the NCE and other partners. The project team was able to interview Ms. Kinnear in order to pose questions regarding the methodology used for adaptation planning in the Yukon Territory and their lessons learned. This information assisted in the development of our own research methods.

We also connected with academics, primarily from the University of British Columbia, who work in the climate change vulnerability and adaptation fields to gather advice and feedback on our project methodology. These researchers included but were not limited to Dr. Tim McDaniels, Dr. Ralph Matthews, Dr. Kai Chan and Dr. Barry Smit (at the University of Guelph).

1.4 Our Approach

After our best practices research was completed, we were able to begin gathering information for the development of the Vulnerability and Risk Assessment. It was decided to use two main methods in order to

1 Keyah (also Keyoh) is a Sekani term used to indicate a territory or subset of a territory that is associated with a particular family or clan. It is a clan's territory within the larger Nation's territory, that is used for subsistence, cultural, and economic sustainability.

collaborate on this study. The first was to meet with the individual Keyah (families) in order to introduce the project to the community and hold discussions with them on climate change observations, concerns and impacts. A follow-up community-led survey was then conducted to collect more detailed information regarding the member's concerns around climate change. Throughout the entire project, updates to Chief and Council about the project's activities and progress were provided, and any feedback was incorporated into the study.

To begin, then, meetings with 13 Keyah were held over a 2-month period and participants were questioned on what types of changes they had observed or were observing both on their own Keyah and on the TLFN traditional lands. Each Keyah meeting was comprised of family members who actively used the territory, and had significant knowledge of the land and resources.

Following the Keyah meetings a community led survey with 25 participants proved effective in collecting more detailed information about observations of changes to the landscape. When applicable, specific site locations were recorded along with the kind of changes observed. The project team analyzed the Keyah interviews and community surveys, identifying climate change vulnerabilities and assigning appropriate indicators for these vulnerabilities. Vulnerabilities were then ranked according to the distribution and frequency of the climate change indicator.

During this time, climate science and mapping were initiated. We used ClimateBC, an online tool developed by the University of British Columbia to generate high-resolution climate data projected to 2020s and 2050s based on an A2 emissions scenario and climate normal, historic data (1960 - 1991). Three climate attributes were selected for mapping climate change over time and for generation of the degree of upheaval map: mean annual temperature (MAT), mean annual precipitation (MAP), and growing degree days (GDD). Growing degree days is the amount of heat energy available for plant growth. These attributes, selected from several generated by the models, were determined to be the easiest to understand and interpret.

The results of this climate science, combined with the local observations and traditional knowledge that was gathered in the meetings, allowed us to finalize a list of vulnerabilities ranked by priority.

Photo (below): Johnny Mikes (CPAWS-BC) speaking about climate change at the Tse Keh Nay Gathering in Moose Valley. Credit: CPAWS

2.0 Summary of Community Information

The Takla Nation has conducted or participated in various projects, studies, and research pertaining to social, health, infrastructure and economic over the past several years. Cultural research, including Traditional Knowledge and Use studies, have been intermittently ongoing since the early 1980s, which has been useful in providing information relevant to the potential effects of climate on all aspects of the health of the TLFN territory.

During this initial project phase, a review of these documents relating to TLFN's cultural, social, bio-physical/ecological, infrastructure, and economic assets and capabilities was conducted in order to ensure that the community's highest priority assets were captured.

Equally important was the need to document and understand what environmental changes were occurring in the traditional territory that could be related to climate change. Knowing what changes were being observed on the landscape and affecting natural resources, and recognizing the impact of these to the TLFN people was a crucial step in being able to understand both the vulnerabilities and the community's adaptive capacity to these changes.

2.1 Existing Socio-Economic, Cultural, Health, and Community Infrastructure Information

In order to support our understanding of vulnerability to the First Nation, existing studies which furthered understanding of environmental, health and social factors, as well as the community infrastructure were reviewed. These included:

- Healthy Lands, Healthy Future - a 3 phased study to determine if there were contaminants in the environment as a result of industrial activity.
- Human Environmental Health Impact Assessment: A Framework for Lake Lake & Stellat'en First Nations in Northern British Columbia, 2009
- Water Resource Management: An analysis of Drinking Water Quality in the Takla Lake First Nation and Surrounding Satellite Reserves, 2010-2011.
- Takla Lake FN Community Socio-Economic Baseline Review for Westcoast Connector Gas, socio-economic report: documenting community demographic and economic profile
- Takla Lake Community Profile, 2009
- TLFN 5 Year Development Plan
- Takla Lake First Nation Ethnohistory Study: a Draft Report, Littlefield, Cullon & Dorricott, 2014

2.2 Existing Cultural Information and Research

It was important to review all existing traditional knowledge and use (TKUS) data for the TLFN lands in order to gain better understanding of the scope and areas of traditional use within the territory. Several TKUS studies had previously been undertaken, with approximately 60 interviews taking place from 1984 to the present. Of these, 45 interviews had been previously digitized, with this digital map information being used in the compilation of Figures 7 and 8 (see section 4.0, pp. 19-20). The remaining TKUS interview paper maps were examined and provided information regarding use areas and use type.

Examination of the 1984 TKUS biographies provided a clear picture of both where traditional harvesting activities took place within the territory and what species of animals, plants and fish were harvested. They also provided information on the location of camping/cabin areas and culturally significant sites. Additional interviews that took place over the ensuing 30 years provided further information on sites, uses and species. This is important information as it gives us a clear window into which areas in the territory experience higher use, and how that use is, or has been changing.

By overlaying the digitized TKUS information with the projected areas of upheaval mapping, we can compare the areas of intense use with those areas which will potentially experience the greatest upheaval due to climate change (Figure 7, p. 19) This provides a clear picture of where those areas are of greatest risk and impact, while the information can be utilized by the community in their future planning. However, there is also a recognition of the current limitations since the TKUS data used was only from the 1984 study. Once the later TKUS interviews have been digitized, there will be increased utility of data. This expanded view will provide a window into both past and contemporary activity locations. By again overlaying these high use areas onto the projected upheaval maps, areas of potential high impact will be highlighted.

2.3 New Cultural Research

New information relating to observed changes in the territory was needed in order to understand the immediate changes that were being observed on the land, with a direct link to climate change. It was important to document observations from TLFN members specifically because this provided a long-term detailed knowledge of specific places that scientists have not surveyed to date.

2.4 Methodology

Two approaches were used to gather this information: family interviews and a community survey.

Interviews were held with family groups, known as Keyah. A pamphlet describing the Climate Change Adaptation Program was prepared to distribute to the community and project participants, in order to facilitate a better understanding of the project's activities and objectives (Appendix C).

Meetings with Keyah holders can pose a challenging task, as the family members are often widespread geographically within the territory. While some may live in the Takla community, others may live in a larger community for medical, educational or economic reasons. Additionally, members often travel out to their Keyah for resource gathering. Each Keyah has a spokesperson, who was approached in order to assist with scheduling where the meetings could take place and identify who the most appropriate Keyah members to attend would be.

To prepare for the Keyah meetings a list of questions was drafted which focused on use of and observed changes within the family use areas (Appendix D). A total of 13 Keyah meetings, comprising of 52 individual TLFN members were held, with digital recordings made of each meeting (Appendix E). This number of meetings and level of participation was considered very successful.

The community survey was conducted with individuals in the Takla Lake First Nation immediately following Keyah meetings. A questionnaire was prepared, with questions broken down into five major sub-groups: Environmental Changes, Climate Changes, Traditional Activities, Extreme Weather, and Access (Appendix F). The survey was structured according to what changes were observed, location of changes, impacts, adaptations, informant number, and the timeframe of observations.

A Takla community member with prior experience in conducting surveys was hired and trained, and participated in the selection of knowledge holders to be included. A total of 25 surveys were conducted in the Takla village over a three week period. Each interview was recorded and then reviewed with the information synthesized into a chart (Appendix G).

Photo (below): Meeting at Takla Landing with Keyah members. Credit: Derek Ingram

2.5 Results

A short summary of the survey results from the community survey is included below, broken into the 5 sub-groups as per the interview.

A. ENVIRONMENTAL CHANGES

The major observation that surfaced was that changes in the distribution and quantity of precipitation has led to less water in rivers and creeks. This has exacerbated the impact of the Mountain Pine Beetle which affects habitat, causes access problems with run-off (due to the deforestation), and poses high concern for forest fire potential.

The above changes in the environment have resulted in changes in the distribution of animals that the TLFN depend on for sustenance.

General patterns observed:

- Fewer animals present, including: moose, beaver, bear, squirrels, caribou, porcupine, amphibians, birds, and rodents;
- Meat from animals hunted tastes different than before (possibly from adapting to new food sources);
- Fewer medicinal plants and berries are available;
- Increased blowdown (due to extreme wind events and poor soil conditions, resulting in more dead trees).

B. WEATHER CHANGES

A high percentage of informants observed that the weather has become more variable, often erratic, and less predictable than in the past. These weather changes have made it more difficult to get sustenance foods in areas historically good for hunting, and hunters have had to go further away from their homes to secure animals. The changing weather patterns have also brought change to the distribution of berry and medicinal plants which have resulted in lower harvesting levels.

Patterns observed:

- Milder temperatures and more abnormal fluctuating temperatures;
- More wind;
- Lakes freezing later in the season;
- Less snowpack and faster melt off in spring; and
- Higher temperatures in the summer months.

C. TRADITIONAL ACTIVITIES

Community survey participants observed increased fire risk, wetlands drying up, drought, changing seasons, and an increase in the number of hunters, which has made it very difficult to perform traditional activities in their territory.

Hunters and food gatherers have had to expand the distance, harvest time and schedule, and yields for collecting foodstuffs for their families.

Patterns observed:

- Water sources drying out;
- Salmon run being delayed;
- Drought in areas that are historically wet; and
- Fewer ungulates and other fur bearing animals.

D. EXTREME WEATHER

A high percentage of survey informants observed that weather in their traditional territory in general was more extreme than it has been historically.

Patterns observed:

- Access problems to use areas;
- Drought periods are escalating;
- More forest fires; and
- Increased blowdown in forest cover areas

E. ACCESS

This category was broken down into three subcategories - access to the Keyah, access to and from the community (from town), and access within the community. A high percentage of community survey informants stated that access for all three subcategories was a significant issue and that weather played a major role in all three. The main issues include: icy roads, blow-down on roads, road washouts, logging roads being given greater priority for grading, and elevated levels of logging truck traffic.

Patterns observed:

- Deeper snow in winter;
- Higher incidence of road washouts in fall and spring due to rainfall and rapid snowmelt, poor condition of culverts, and blow out of beaver dams; and
- Increased incidence and intensity of winter storms.

3.0 Climate Mapping

Climate mapping was done by a team of GIS specialists using ClimateBC Version 4.7. To map climate change over time, three climate attributes were selected: mean annual temperature, mean annual precipitation, and growing degree days. These attributes were selected for facility in understanding and interpretation.

Models for two projected time periods were then generated to show climate change. The 2020 model covered 2010-2039 while the 2050 model covered 2040 to 2069. The project team selected the 2020s time period as it is more meaningful to the community and is supported by findings from our regional scan of northern adaptation plans.

3.1 Climate mapping results for the 2020s

By the 2020s (2010-2039) climate within the study area is projected to become warmer (median of +0.9 °C), wetter (median +4%), and with an increased number of growing degree days (+140 degree days).

The following maps were created to display and interpret the projected changes in three important climate variables (annual temperature, annual precipitation, and growing degree days). There are several additional climate variables produced in the modeling process (e.g. snowfall, heat, frost-free days, Summer-Heat Moisture index), although they were not applicable for the purposes of this report and therefore not included. Mean Annual Temperature (MAT) and secondarily Growing Degree Days (GDD) are the most important variables. Mean Annual Precipitation (MAP), including rain plus snow, did not change enough to significantly affect the projection for the 2020s. MAP always increases, but not by a lot. If MAP had decreased in some areas then there would have been a much greater impact in combination with rising MAT. This is especially true along the Stikine River and in the southwestern part of the study area where climate is already relatively dry.

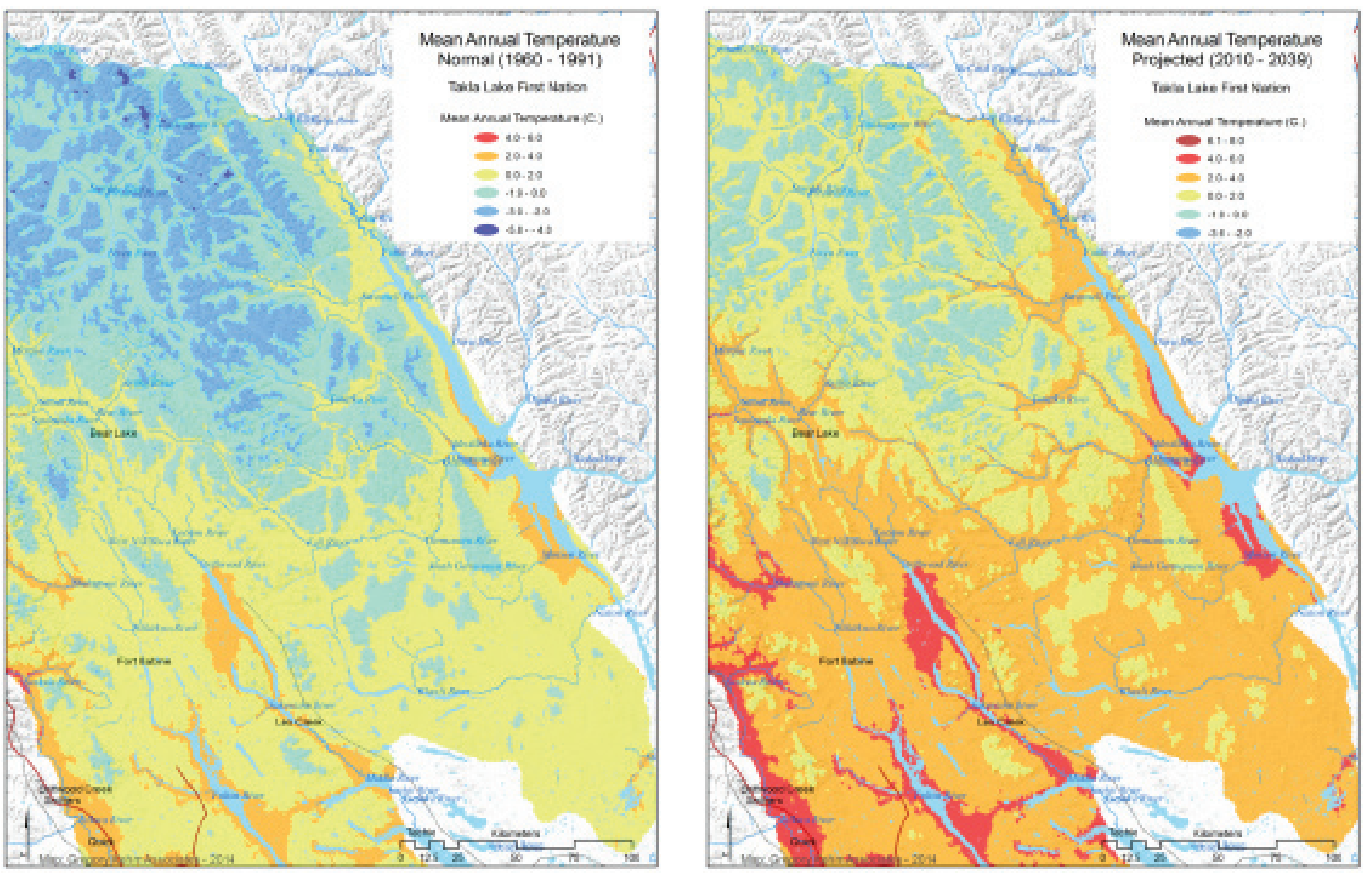

Figure 2. Mean Annual Temperature, normal and projected to 2020's. Warming trend across the study area.

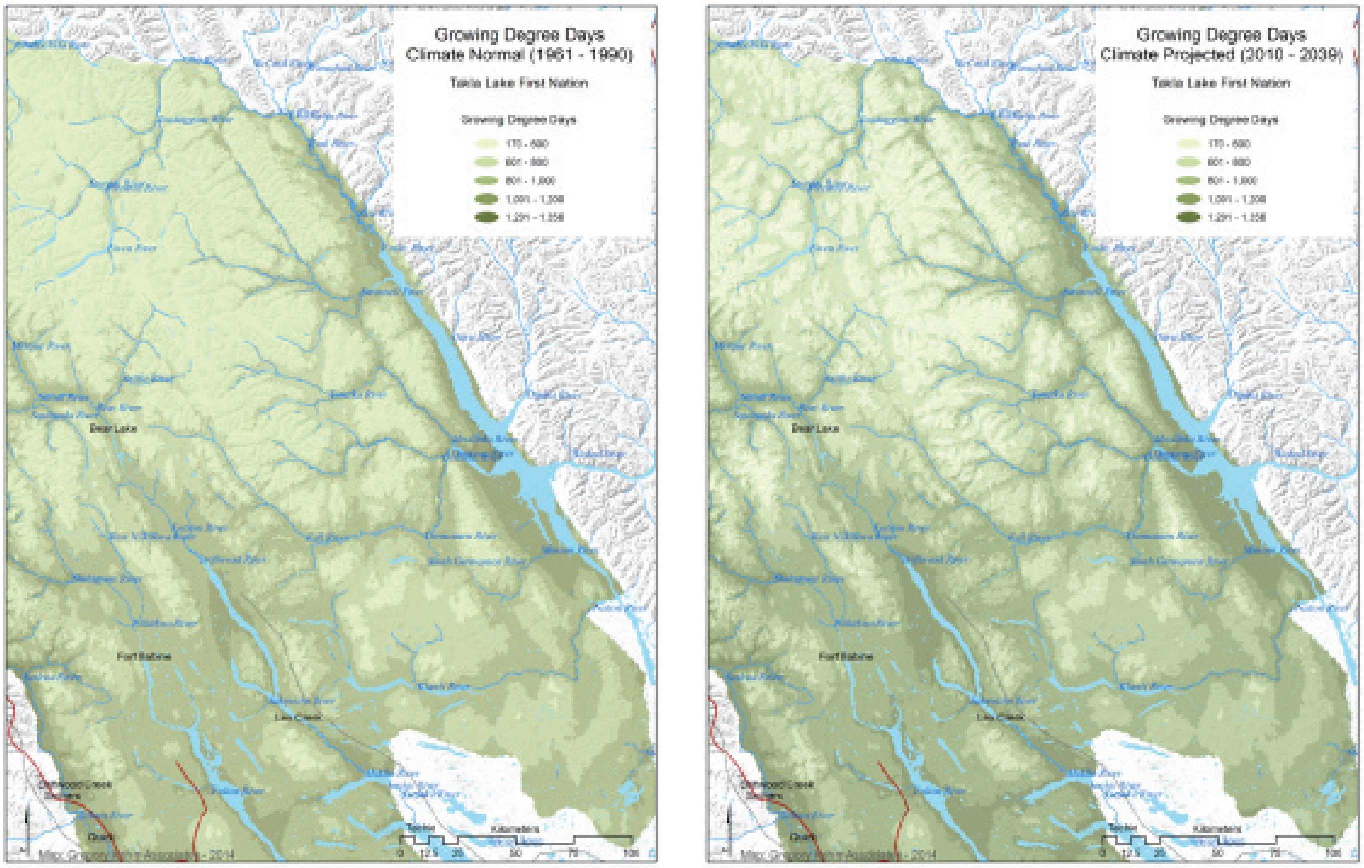

Figure 3. Growing Degree Days Normal and Projected to 2020’s (annual period). Degree days above 5 °C increase, pronounced in valleys and northerly extent.

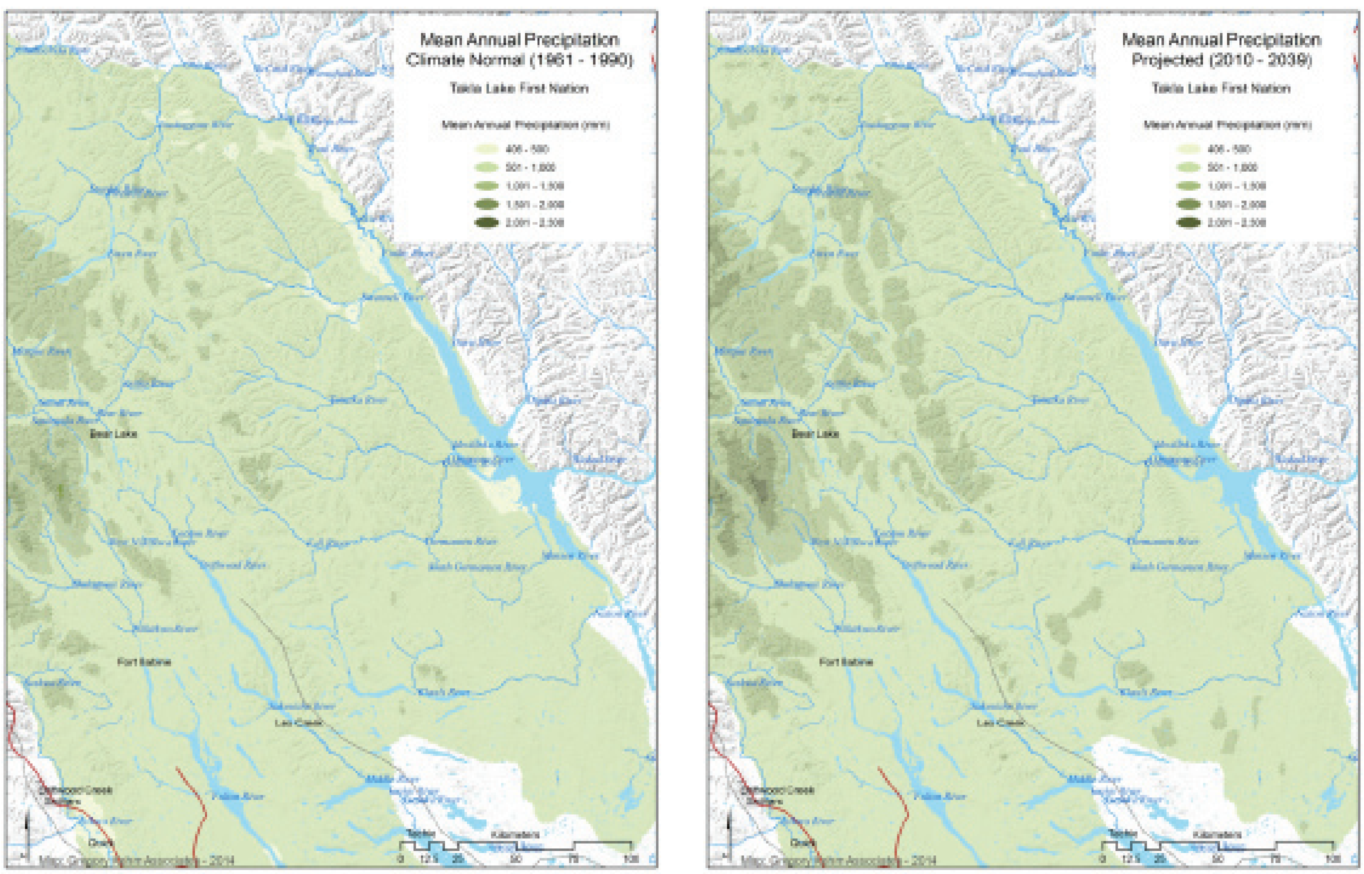

Fig 4. Mean Annual Precipitation Normal and Projected to 2020’s (annual period). Modest increases. Data gaps in the normal period make this climate model attribute less reliable than the others.

3.2 ClimateBC models: summarized outcomes

The single climate projection used for the maps is the CGCM3 A2 run 4. CGCM3 is the Canadian Global Climate Model, developed by Environment Canada's Canadian Centre for Climate Modelling and Analysis (CCCMA) at the University of Victoria. The A2 specification denotes a possible future where emissions continue to rise alongside increases in human population and economic growth. The Intergovernmental Panel on Climate Change (IPCC) has created several emissions scenarios to choose from and the project team selected the A2 due to its relevance and fidelity for a near-term planning horizon used in this project.

The model results were interpreted in terms of the change in temperature, precipitation, and growing degree days between climate normal period (1960 – 1991) and the 2020s to identify threshold changes in projected ecological systems. The change in these climate attributes is analyzed within a spatial polygon defined by a combination of physiographic sub-provinces (a purely physical land classification within BC) and biogeoclimatic units (a finer biological and physical land classification).

3.3 Climate Matrix and Projected Degree of Ecological Upheaval

We reviewed existing ecological classification reports pertaining to the study area to estimate the degree of ecological upheaval due to projected climate change. The environmental characteristics of the biogeoclimatic ecosystem classification (BEC) units that occur in the study area were reviewed in terms of elevation, physiography, climate, landforms/soils, and vegetation. The means and ranges of climate normals (typically 30-year normals for 1961 to 1990) were extracted for recording stations in the region's BEC units.

A matrix of historic (1961 to 1990) and projected climate normals was created for MAT, MAP, and mean accumulated GDD (1991 to 2020s, as per CGCM3:A3 model and scenario - Third Generation Coupled Global Climate Model by CCCMA). We used analytical data for the region generated using ClimateBC, a web-based tool developed at UBC Forest Sciences, based on data from available recording stations accumulated between 1961 and 1990. The difference (ΔT, ΔP, ΔDD) was calculated between historic and projected values for each combination of physiographic subprovince and BEC unit. We ranked the differences in terms of classes of intervals of change. Intervals were determined by mean values and ranges that characterise contemporary BEC units and differentiate, for example, boreal/subarctic, subalpine, alpine and temperate environments, or subhumid, humid and very humid climates. The complete climate matrix table is found in Appendix H.

Photo (below): Omenica River and mountains, Elyse Curley

Fig 5. Physiographic Regions, Greater Takla Lake Study Area

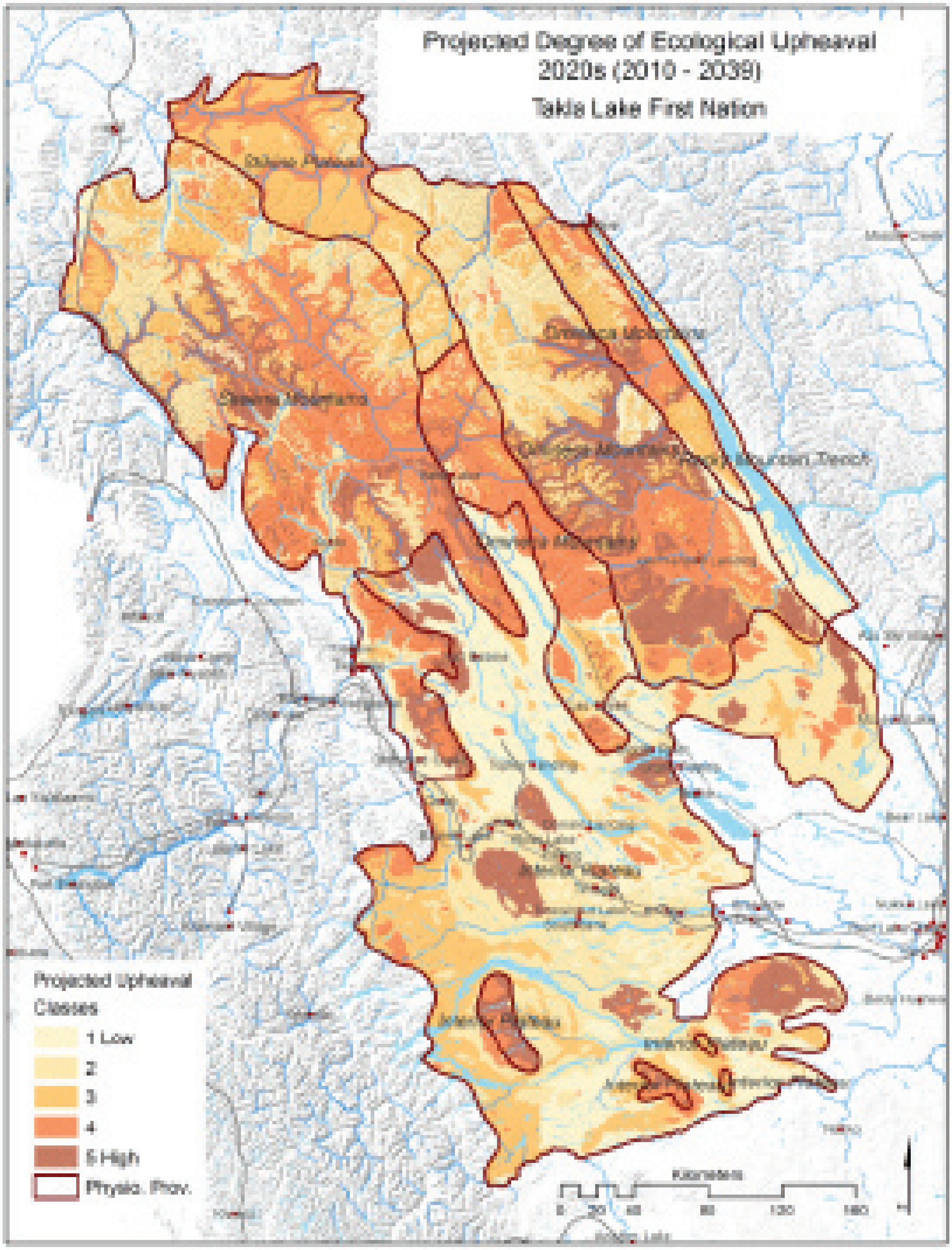

Fig 6. Projected Degree of Ecological Upheaval, Greater Takla Lake Study Area

3.4 Summary and Interpretation of the Degree of Ecological Upheaval Layer by Physiographic Province

OMENICA MOUNTAINS

It appears the Boreal Altai Fescue Alpine (BAFA) in the Finlay Ranges and Rocky Mountain Trench doesn't warm sufficiently to push mean annual temperature (MAT) much above 0 degrees C, if at all. Therefore, relatively minor upheaval is projected in that northern alpine zone. The Swannell Ranges are somewhat similar although the range of upheaval is wider and likely a greater upheaval in the southern part of this physiographic unit. Whereas in the Hogem Ranges warming often elevates MAT above the threshold, and even more so in the Nechako Plateau alpine; thus greater alpine upheaval is projected.

This trend appears for Spruce-Willow-Birch (SWB) in Finlay, Swannell, Hogem Ranges. Not enough increase in MAT or Growing Degree Days (GDD) to push MAT much above 0 degrees Celsius, if at all.

The Englemann Spruce – Subalpine Fir (ESSF), generally (and across most physiographic units) is projected to have more upheaval—especially in the parkland subzones—again because projected increases in MAT & GDD sufficient to get MAT above the threshold, in some cases expand Sub-Boreal Spruce (SBS) & Interior Cedar--Hemlock (ICH) at the expense of lower elevation parts of ESSF, and promote tree ingress in, and upward creep of, the parkland subzones. The effect is weakest in the ESSFmk&mc (where MAT is already well above 0 degrees Celsius) of Nechako Plateau and the ESSF mvp (where historic MAT is well below 0 degrees Celsius) of Rocky Mountain Trench.

Relatively minor upheaval projected overall for the SBS—all subzones and physiographic units, in which the zone is already relatively warm and the changes in MAT & MAP are moderate, not enough to switch things to ICH or IDF—except for the SBSmc2&un in the Skeena Mountains, where changes mostly look sufficient to move into an ICH envelope.

BWBS generally looks like it's in for a major projected upheaval, primarily because of significant warming, possibly enough to push into SBS. Anomalies might occur in BWBS of Hogem Ranges (where BWBS is already relatively warm), of Skeena Mtns (where historically colder) and the Rocky Mountain Trench (less increase in MAP & GDD).

STIKINE PLATEAU

Significant change is projected for the Boreal White Birch Black Spruce (BWBS) biogeoclimatic unit, mostly because of increased MAT and GDD. It is already a relatively warm boreal unit, especially down towards Telegraph Creek, and could get pushed toward a Sub-Boreal Spruce (SBS) type of climate. Less projected upheaval is indicated for Spruce-Willow-Birch (SWB), but there is enough projected shift to move some of it toward Englemann Spruce – Subalpine Fir (ESSF), and for conifer species to spread into what is now subalpine woodland (open forest) and shrublands. Boreal Altai Fescue Alpine (BAFA) upheaval is not anticipated to be high, because the temperature increase is still not enough to raise the MAT above 0 degrees Celsius, for the most part.

SKEENA MOUNTAINS

The most dramatic projected upheaval in northern Skeena Mountains is for those valleys most susceptible to coastal air masses intruding farther inland than previously, and perhaps pushing (SBS) inwards. Some examples of this include: Rochester Creek and Slowmaldo-Damdochax area and upper Nass River (above Muckaboo Creek) toward warmer and a bit wetter Interior Cedar--Hemlock (ICH) conditions, possibly pushing ESSFwv in Muckaboo, Konigus and upper Nass (up to Nass Lake) towards ICH as well. Passing over the drainage divide into the Little Klappan there is an area of BWBS (projected to warm up significantly) and subalpine zones (ESSF & SWB) projected not to change as much, perhaps because the warming isn't enough to get MAT too far above 0 degrees celsius. In other words, this remains a generally boreal climate within the Stikine watershed.

Similarly, moving up the Skeena valley above Kuldo, the ICH already exists in the valley bottom and the projected change (mostly warming) is insufficient to move out of ICH (to CWH, for example). Although, at higher elevations there is enough projected warming to expand ICH, generally, into ESSF and maybe convert some ESSF to Mountain Hemlock (MH), and to switch from SBS (above Slamgeesh) and some ESSF to ICH all the way to the "Sacred Headwaters." This is into the upper Klappan drainage and back into the Stikine watershed and SWB, which generally isn't projected to warm enough to move into ESSF.

NECHAKO PLATEAU

It appears from the map that several sizeable areas of ESSF have the highest projected upheaval, probably because warming promotes upward expansion of the matrix of SBS in which the subalpine is embedded, and also expansion of ESSF forest and parkland upward. Areas like Quanchus Range, Fawnie Range, and the area between Francois Lake and Houston, Matzehtzel Mountain. It is not clear how to interpret the projections south of Vanderhoof and south of Cheslatta Lake, although it appears SBS will persist. Generally SBS is not projected to undergo great upheaval, although you could argue retrospectively that it already has, due largely to warming to date and manifested as the mountain pine beetle outbreak.

The BAFA in the Finlay Ranges and Rocky Mountain Trench doesn't appear to warm sufficiently to push MAT much above 0 degrees C, if at all. Therefore relatively minor upheaval in that northern alpine. Swannell Ranges somewhat similar although the range of upheaval is wider, probably greater upheaval in the southern part of that physiographic unit. Whereas in the Hogem Ranges warming often elevates MAT above the threshold, and even more so in the Nechako Plateau alpine; thus greater alpine upheaval. This is similar for SWB in Finlay, Swannell, Hogem Ranges: not enough increase in MAT or GDD to get the MAT much above 0 °C, if at all.

The ESSF generally (across most physiographic units) is projected to have more upheaval, especially in the parkland subzones, because projected increases in temperature and growing degree days is sufficient to get MAT above the threshold, and in some cases expand SBS & ICH at the expense of lower elevation parts of ESSF. This will promote tree ingress in, and upward creep of, the parkland subzones. The effect is weakest in the ESSFmk &mc (where MAT is already well above 0 degrees) of Nechako Plateau and the ESSFmvp (where historic MAT is well below 0 degrees) of the Rocky Mountain Trench.

Relatively minor upheaval is projected generally for the SBS—all subzones and physiographic units, in which the zone is already relatively warm and the changes in mean annual temperature and precipitation are moderate, and not enough to switch ecosystems to ICH or Interior Douglas Fir (IDF)—except for the SBSmc2&un in the Skeena Mountains where changes mostly look sufficient to move into the ICH envelope.

BWBS generally looks like it's in for a major upheaval. This is primarily because of significant warming - enough to push into SBS. There are some anomalies projected in the BWBS of Hogem Ranges (where BWBS is already relatively warm), and Skeena Mountains (where it is historically colder), and the Rocky Mountain Trench (where there is less increase in MAP & GDD).

Photo: View across Takla Lake from Old Landing. Credit: Michelle Sinclair.

4.0 Bridging Cultural Research and Climate Science

The TLFN community has been collecting cultural use and knowledge information for the purposes of both preservation of cultural knowledge as well as for future land planning. The information includes areas of importance for resource use, culturally significant sites and areas, traplines, habitation places and trails.

Climate science has given us an opportunity to see what changes will take place over time, both to temperature and to the environment. It has enabled us to create maps that show which geographic and ecological areas will be more vulnerable to the changing climate.

By having the knowledge of what land use changes will likely occur as a result of climate changes, and combining it with the areas of ecological importance for sustenance and culture, the TLFN can understand which areas of use will be more highly impacted by climate change.

The following maps show combined information from both cultural research and from climate science. Figure 7 shows areas of traditional sustenance activities, based on an extensive traditional use study done in 1984 by the TLFN. These have been imposed on the Degree of Ecological Upheaval map. Figure 8 contains habitation (camping and campsites) sites from the same TUS, again over-layed with the Degree of Ecological Upheaval map.

What these maps allow us to clearly see is that many areas which are used intensely by the TLFN for traditional practices and sustenance coincide with areas of high vulnerability for ecological upheaval. That is, these areas will be highly impacted by the changes in the climate.

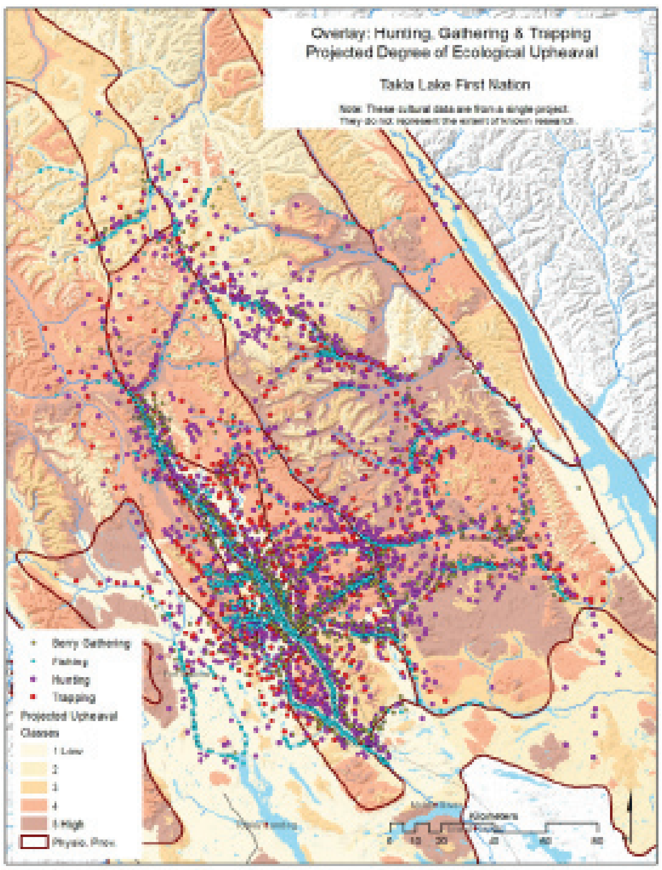

Fig 7. Areas of Hunting, Gathering & Trapping and Projected Degree of Ecological Upheaval, Greater Takla Lake Study Area

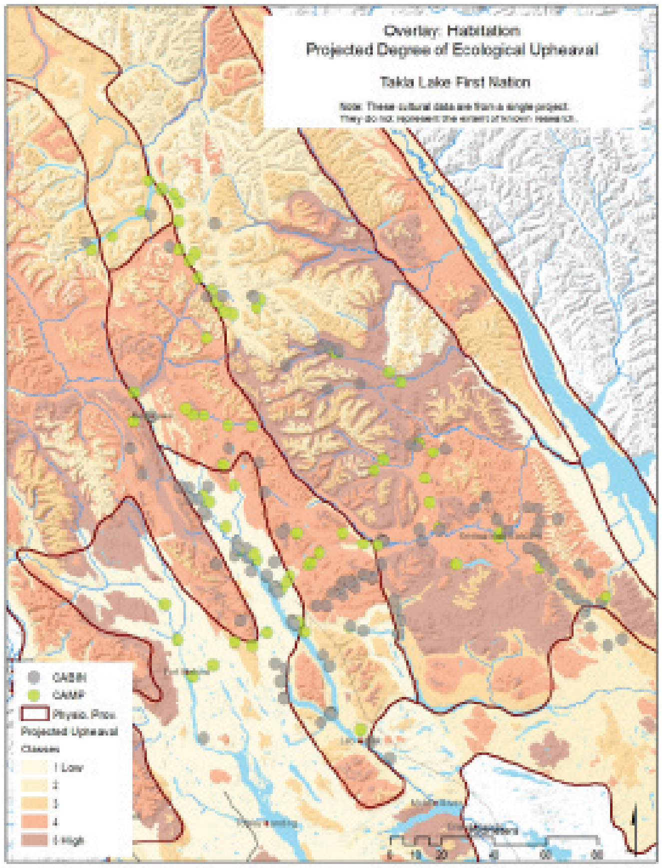

Fig 8. Areas of Habitation and Projected Degree of Ecological Upheaval, Greater Takla Lake Study Area

4.1 Climate Change Induced Community Vulnerabilities and Risks

Appendix I contains a summary of induced community vulnerabilities that may result from climate change. These vulnerabilities were extracted from the results of the community survey as well as from the meetings with the Keyah groups. In reviewing informants' comments a number of cross-cutting issues that introduce vulnerability emerged. Here we discuss these interrelated issues and vulnerabilities according to three focus areas: food security, extreme weather events, and emergency management.

FOOD SECURITY

TFLN's access to their traditional territory is a major issue for the community, namely for hunting, trapping, gathering, fishing, traditional medicines, and obtaining other resources. In addition to providing essential food and sustenance for TLFN members, these traditional activities are essential to the well-being of the community and the endurance of their culture.

Observations from both the survey participants as well as from the Keyah meetings indicated that changes in precipitation and temperature are resulting in decreases in the water levels in lakes and creeks, increasing water temperatures, causing wetlands to dry up, impacting the freeze level and amount of snowpack in winter, and resulting in hotter, dryer conditions in the territory.

These changes are impacting both availability of and access to food and medicine resources. Changes to the location, quantity and quality of animals, fish, plants and berries is occurring, as well as to the seasonal pattern (timing) of harvest. Both the quantity and quality of food resources is decreasing. Access to resources throughout the year is also being impacted, with less snowpack and frozen water bodies affecting winter access, run-off resulting from faster melting causing flooding and slides during the spring, and concerns with increased fire hazard resulting from drier conditions and pine-beetle during the summer and fall.

In response, hunters and food gatherers have had to increase the distance travelled and time spent in search of food for their families, as well as shift the timing of hunts and harvests. Despite this, yields are diminishing - a factor which is due to both climatic changes but also to the increased number of non TLFN hunters which are entering and utilizing the territory.

Concerns related to food security also overlaps with many those related to water, including: disappearance of glaciers, reduced snowpack and water levels, reduced numbers and quality of fish, and, industrial impacts (e.g., contamination from mines tailings, new pipelines, powerline corridor spraying with herbicides).

Photo: Trees affected by pine beetles, Elyse Curley

EXTREME WEATHER EVENTS

The TLFN is also facing challenges resulting from incidences of extreme weather events, which are occurring in both the community and throughout the traditional territory. These events, which have been noted to be increasing over the past 10-15 years, are affecting the TFLN community in several ways, most notably flooding and increased storm intensity.

Flooding: While rainfall is less frequent, it is coming in periods of increased intensity. As well, there appears to be a faster rate of snowpack melt resulting from warmer temperatures (a shorter winter), affecting the time and duration of run-off. The impacts of the pine beetle epidemic combined with increased industrial activities have further compromised the ability of the soil to absorb precipitation, potentially also leading to landslide activity. Existing culverts are not able to efficiently handle the increased peak water flow. Vulnerabilities identified with the increased flooding include water quality, damage to property, effects to fish and animal habitat, and access (into the communities, within the communities, and into the Keyah).

High Winds and Increased Storm Intensity: A major result of the increased extreme wind and storm events is frequent downed trees, leading to power outages in the community. These power losses in Takla Landing result in loss of communication (phones, computers) and causes damage to freezers, directly leading to spoilage and loss of stored foods. Blowdown in forested areas also creates access problems, while accumulated debris poses a fire threat. Increased wind is causing the land to dry out quickly after a rainfall, affecting the quantity and quality of plants and berries. High winds and intense storms pose significant threats for fire.

EMERGENCY MANAGEMENT

Climate change impacts are expected to affect the TLFN's emergency management systems. In order to effectively prepare for possible emergencies, the community needs to be aware of potential situations related either directly or indirectly to these.The themes for emergency management are crosscutting with those of extreme weather events, and are also related to food security issues.

Extreme fluctuations in rivers and lakes potentially pose several threats. Increased rainfall intensity and condensed periods of snow melt will lead to overflows in rivers and lakes and result in increased flooding in the territory. The fluctuations in precipitation amounts and durations, along with warming temperatures can also result in both landslides and avalanches, and can contribute to the instability of mining tailings ponds and pipeline ruptures.

With longer and drier periods now occurring, lower lake and river levels could potentially lead to decreased quantity and quality of drinking water, threatening human health. Less precipitation during the summer and fall is impacting the health of the plants and animals that the community depends upon for traditional sustenance.

One of the most prevalent concerns expressed by the community members is that of fire. There has been an increase in both the number and intensity of fires in the territory. Pine beetle infestation and large amounts of deadfall have also added to the dry fuel in the forested lands, making the threat of fire even more of a concern. This fear is impacting the activities of families who travel to their Keyah to secure traditional foods and resources.

Concerns of access were also frequently expressed during the interviews. Access to and from the community as well as to the Keyah lands are being impacted or threatened by road and bridge washouts, landslides, flood waters, and fire hazard.

5.0 Conclusion and Next Steps: New Questions, Needs and Opportunities

The results of this project confirm that our climate is changing and the impacts are being experienced now, and that this has profound implications for the TLFN and their way of life. Global climate change may be beyond the control of the TLFN, but there are specific actions that can be taken to anticipate and mitigate the impacts that are experienced at the local level.

First Nations people are masters at adaptation, and over millennia they have been challenged by (and responded to) many changes to their environment. Today, climate change poses new challenges, occurring more rapidly than previously, and with a much broader effect.

Because of their remote location, their system of stewardship, and the determination of the community, the TFLN continue to preserve their traditional way of life and to continue to use and thrive in the natural environment. TLFN will have many challenges similar to other communities, but also face many unique challenges.

As witnessed in the community responses, changes in the local climate are already being experienced, and adaptations to these changes are already being developed to some extent. Changing locations for hunting, fishing or gathering, changing the time or season that they hunt, for example, are adaptations that can and are being made. However, the real challenge is the cumulative impacts of climate along with the pressures of incoming industries operating on the landbase, and the increasing accessibility to outsiders. The depletion of sustaining resources is a very real and urgent concern for the community, and the pressures of competition for these resources, such as hunted game, will only increase over time. Climate change and traditional use of resources must be incorporated into cumulative effects assessments.

The impacts that climate change has had (and will have) on the community are very complex. Many impacts associated with climate change are linked to a number of cross-cutting vulnerabilities. For example, the pine beetle epidemic, a result of warmer winters, has decreased available wildlife habitat, reduced the soil's ability to absorb runoff (and thereby causing landslides). Furthermore, the resulting dead trees have increased fire danger and power outages associated with downed power lines causing power outages in the community and loss of food in freezers. Meanwhile, changes in the amount of snow and freezing times affects access to the TLFN and the community to their traditional resources. Stronger winds, moderate temperatures and changes in water quality and quantity may affect biodiversity and habitat. Multiple vulnerabilities are linked to increased incidence of fire, and present challenges to be addressed, both immediately and in the long term.

This all serves to illustrate how issues such as food security, extreme weather and emergency management are all linked.

Photo: Cabin at Old Landing. Credit: Michelle Sinclair.

Climate change will also have impacts on Takla's infrastructure and on their economy, for example, the loss of forested lands due to the pine beetle epidemic, soil erosion, and the loss of areas for ecotourism.

There will be both long-term and short-term shifts due to climate change. These shifts will impact the vulnerabilities, with some vulnerabilities more critical 'time-wise' than others. Danger of fire is one of the highest priority threats to the TLFN, as some Keyoh lands are remote and access can easily be cut-off by fire. This situation has already occurred in the past and the risk will increase as the changes in climate continue and accelerate.

In addition to these negative impacts, there is the possibility that these changes could potentially result in positive outcomes that are supported by new ecosystem types (e.g. new areas for berries). These changes could also present opportunities for economic gain through both long-term and short term jobs. However, it may be too early to tell what the impacts are going to be or how the ecosystems will shift.

The impact of climate change to the Takla Lake First Nation traditional territory is complex and assessing it requires working with local people, indigenous and non-indigenous, to better understand what changes may be coming.

RECOMMENDATIONS

Awareness of the impending changes and potential impacts needs to be followed by development of 'community derived' strategies to minimize the negative impacts on their lives and traditional practices. It is recommended that a meeting be held with interested members of the community to discuss the implications of this report and next steps. Below is a list of recommendations that should be considered. Many of these recommendations would create employment for community members, but will require funding (potentially from industry and/or and government) to implement.

1. Improve hydro right-of-way clearing to decrease blowdown-induced power outages
2. Provide funding for a community generator for power outages in Takla Landing
3. Improve road maintenance both to the Takla Landing community and within the community.
4. Fund a community transport vehicle for travel to service towns
5. Provide satellite phones for members to use when accessing their Keyoh lands
6. Initiate an environmental monitoring program to track climate change and impacts
7. Open up old trails in areas less impacted by climate change for better access for traditional resource gathering.
8. Incorporate climate change modelling and traditional use into cumulative effects assessments

Photo: Takla Landing. Credit: Michelle Sinclair