Workshop Summary: Adapting Nadina Forest Management to Climate Change

Workshop held April 12, 2011, Burns Lake, BC.
Summary by Dave Daust, Don Morgan and Ken Zielke, April 30, 2011

Participants

Name	Affiliation
Agathe Bernard	FLNRO[a] – Nadina District
Alex Woods	FLNRO – Skeena Region
Alison Patch	Nadina Woodlot Association
Carolyn Stevens	FLNRO – Nadina District
Cyril Thacker	HFP-West Fraser
Dave Daust[b]	Consultant, Telkwa
Dave Wilford	FLNRO – Skeena Region
Dion Oake	Fraser Lake Sawmills
Don Morgan[b]	Ministry of Environment
Doug Steventon	FLNRO – Skeena Region
Garth Ehalt	HFP-West Fraser
Jim McCormack	CANFOR
Ken Zielke[b]	Symmetree Consulting
Matt Sakals	FLNRO – Skeena Region
Rick Heinrichs	FLNRO – Skeena Region
Sybille Haeussler	University of Northern BC

[a]Ministry of Forests, Lands and Natural Resource Operations.
[b]Facilitators

Due to short notice, Wet'suwet'en representatives could not attend, but provided written input that was reviewed at the workshop (Appendix 1).

Introduction

Dave Daust provided an overview of the Nadina climate change project and described the purpose of the workshop. This workshop is part of a climate change vulnerability assessment project addressing forest management in the Nadina Forest District. The project began in 2010. The project translates global climate change projections into projected changes in ecological function and ecological services relevant in the Nadina Forest District (Figure 1). It goes on to ask how managers might best respond to these projected changes (i.e., "adaptation") and what barriers prevent adaptation. Earlier workshops focussed on ecological change. This workshop focused on management responses and barriers.

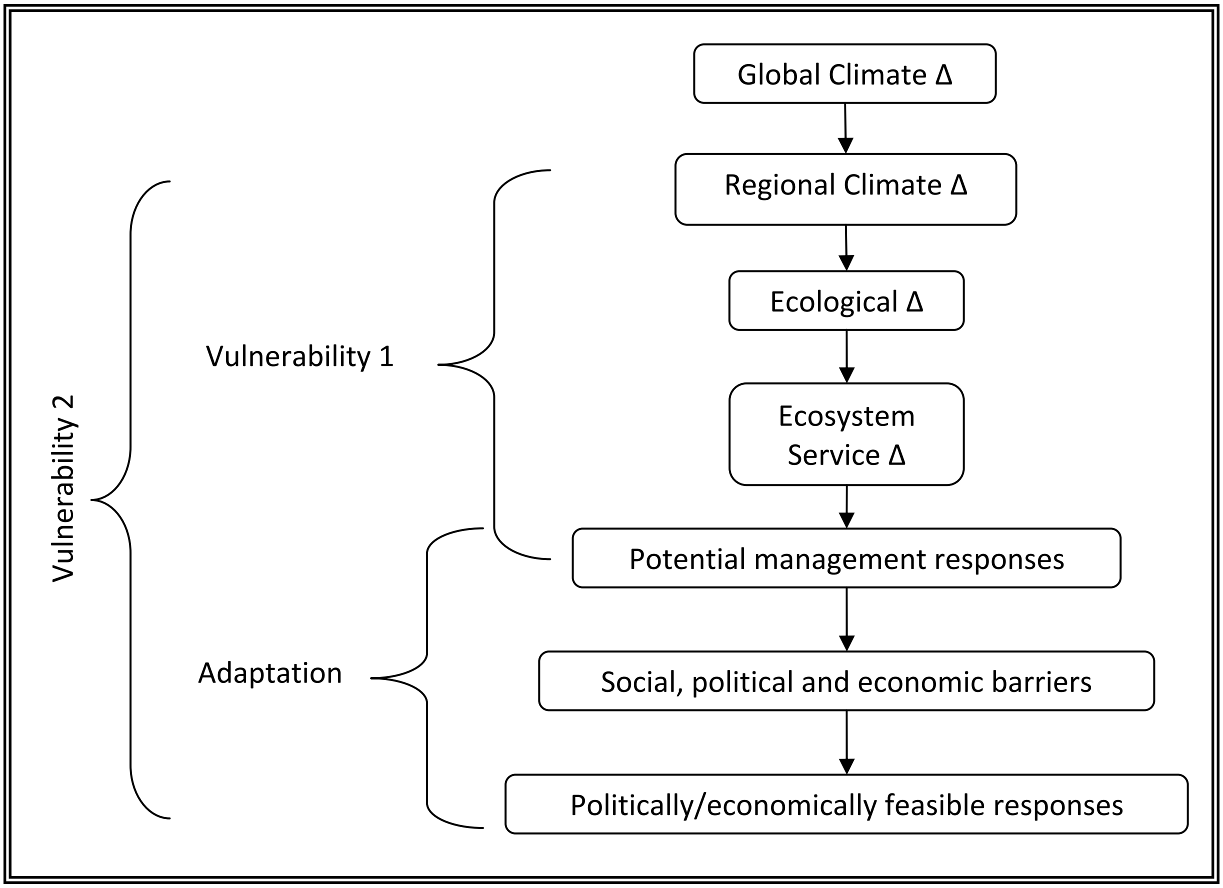

Figure 1. Steps in the Nadina type 2 vulnerability assessment. This workshop focused on adaptation.

Don Morgan presented an optimistic and pessimistic scenario describing different types and magnitudes of climate-induced change relevant to BC (see climate change narratives[1]). The scenarios were presented as historic summaries told from 50 years in the future. The optimistic scenario assumes that society has tackled climate change by reducing greenhouse gas emissions and by adapting management strategies (across a range of sectors) to better cope with climate change. The pessimistic scenario assumes society has not addressed climate change. While the future cannot be accurately predicted, it is likely that mitigation (reducing CO^2 emissions) and adaptation efforts will reduce the negative impacts of climate change to some extent as depicted in the optimistic scenario. At the broadest scale, forest managers must decide whether or not they wish to tackle climate change and contribute to the optimistic path.

Dave Daust reviewed climate-induced ecological changes relevant to biodiversity, trees and timber, and hydrology and aquatic resources. Biodiversity, trees/timber and hydrology/aquatic resources were selected as focal ecological services in the first project workshop[1]. Three "technical" workshops[1], one for each focal service, then identified key ecological changes and outlined potential impacts to ecological services.

[1] http://bvcentre.ca/research/project/a_multi-scale_trans-disciplinary_vulnerability_assessment/

In this workshop, break-out groups (one for each focal service) reviewed and revised the summarized changes in ecological functions and services. They identified potential management responses for each change, describing practice, monitoring and planning steps that might be adaptive (i.e., limit negative impacts or capitalize on potential benefits). They roughly estimated the magnitude of the management influence.

The three sections below summarize ecological changes and potential management responses for timber/trees, hydrology/aquatic resources and biodiversity. They also summarize anticipated net changes to ecological services and potential management responses. Changes in ecology and in ecosystem services are based on earlier workshops but include revisions from this workshop. Management responses come from this workshop. After these three sections addressing anticipated changes and potential management responses, two final sections describe barriers to adaptation and options for moving forward.

Trees and timber

Participants in the trees/timber breakout group identified management responses to specific ecological changes (Table 1) and to changes in ecosystem services (Table 2).

Table 1. Management responses to ecological changes that affect trees and timber.

Ecological Change[a]	**Initial sensitivity by site/region**[b] **and potential management influence**[c]	**Management Response**
Tree growth ↑	LM→M overall (M on sites without moisture stress; L on sites with moisture limitations).	**Practices** Select species and genetic stock that are drought resistant (big impact). Fertilize sites with low moisture stress to take advantage of improved growth potential. Explore site preparation options (e.g., V-plough) to increase moisture during establishment on dry sites – will only improve early growth. Partially cut stands to retain shelter and moisture – again will only improve early growth. Short rotations (get it while you can) (big impact). Proactive root disease management (e.g., remove stumps) (big impact on specific sites).
Fire mortality ↑	H→H? in dry eastern plateau. L in wet western mountains. Some ability to limit consequences mostly via control. Fire prevention may be more difficult. Again fuel management may just limit the consequences of fires that get started.	**Practices** Fuel reduction (mainly around communities). Leave broadleaf strips on landscape as a firebreak. Reduce fuels at harvest via broadcast burning, other site prep, mulching or piling, or chipping for bioenergy. Capture water in man-made reservoirs across the landscape to increase fire control potential. Increase road density to improve fire control access. Control access better via gates during fire season to reduce ignition risk. Provide more and better suppression equipment on site with logging. **Monitoring** Monitor fuel loads by site treatment.

Ecological Change[a]	**Initial sensitivity by site/region**[b] **and potential management influence**[c]	**Management Response**
		Planning Plan broadleaf strips. Plan access controls. More strategic planning around harvesting, addressing site hazards and necessary equipment. Strategic planning, hazard mapping and fuel management priority ranking around communities.
Bark beetle mortality ↑	H → LM (overall) marginal impact in established stands (opportunity with new stands). Initial sensitivity: H for pine component; MH for spruce; MH for balsam.	**Practices** Increase species diversity (e.g., during planting). Fertilize existing age 2, 3, (4) to shorten rotation and then replant more resilient species. Target most susceptible stands for shorter rotations. Will need to develop markets for the supply of smaller wood. Timely control based on increased monitoring, especially as susceptibility grows. **Monitoring** Increased monitoring of beetle damage (divert fertilization $). **Planning** Strategic plan for landscape diversity across TSA. Develop plan that identifies sites that should be harvested early. Need TSA (perhaps regional) scale plan on species deployment.
Diseases of young stands ↑	MH→M in pine leading plantations in SBS mc2 (Dothistroma).	**Practices** Increase species diversity in plantations. Facilitate migration (species and genotypes); e.g., Fd, Lw, Hw and broadleaf. Increase stocking density (note that this may increase drought stress and snowpress). **Monitoring** Monitor past free growing stands to identify site types and species combinations at risk (supports planning). **Planning** Develop TSA-scale strategy that identifies sites that will benefit the most from facilitated migration investments. Influence genetic/breeding program to increase emphasis on disease resistance (benefit? hard to estimate).
Maladaptation due to climate-stress ↑	H→H? on dry sites. L on moist and wet sites. Also, maladaptation may make brush species relatively more competitive.	**Practices** Targeted harvest and reforest with more resilient species (if possible, as per strategy). Or remove from THLB. **Monitoring** Identify sites facing climate stress. Monitor changing conditions of stressed stands. Continuous Forest Inventory needed to track changing tree growth and mortality. **Planning** Strategic plan to address stressed sites. Revise TSR if THLB changes and if growth rates change.

Ecological Change[a]	**Initial sensitivity by site/region**[b] **and potential management influence**[c]	**Management Response**
Forest-scale resilience ↓	M →M (perhaps increase); may vary by BEC zone.	**Practices** Increase species diversity. Increase initial planting density. Increase age class diversity. More mixed wood and deciduous types. Increased structural diversity in general. **Monitoring** Monitor stands. **Planning** Need strategic plan to implement practices.

[a]Columns 1 and 2 are based on the timber workshop, November 2010, and on modifications from this workshop.
[b]Sensitivity (most likely magnitude of change over the next 50 to 100 yr): Low, Low-Mod, Mod, Mod-High, High.
[c]Magnitude of influence shown as shift in sensitivity due to all management actions (e.g., High → Mod).

Table 2. Management response to changes in timber-related services.

Ecosystem service change[a]	**Initial sensitivity**[b, c]	**Management Response**
Timber supply ↓	M-H	**Practices** Better utilization. Timely and targeted salvage. Thoughtful fertilization (late rotation?). See other stand-level adaptation strategies related to species and stocking (etc.). **Monitoring** Monitor problem forest types up front so can harvest in timely manner. Monitor growth and yield to recognize changes due to climate. Create a continuous (running-operational) inventory that makes use of LIDAR. **Planning** Develop strategic plan to prioritize harvest of susceptible stands. Develop strategic plan to diversity products to match changing log supply. Improve Timber supply models (and include ECA indicator) to reflect changing mortality rates and yields.
Percent salvage ↑	H	See response to decreased timber supply above.
Plantation failures ↑	M	See responses to disease in young stands and maladaptation in Table 1.
Road access per m^3 ↑	L	Current road density unlikely to limit salvage.
Shutdown periods ↑	L	Existing approaches and technology will limit any impacts.

[a,b]See footnotes from table above.
[c]Change in sensitivity due to management not estimated.

Hydrology and aquatic resources

Participants in the hydrology/aquatic breakout group identified management responses to specific ecological changes (Table 3) and to changes in ecosystem services (Table 4). Appendix 2 provides additional rationale for focussing adaptation efforts on hydroriparian ecosystems.

Table 3. Management responses to ecological changes that affect hydrology and aquatic resources.

Ecological Change[a]	Initial sensitivity by site/region[b] and potential management influence[c]	Management Response
Summer water temp ↑ due to longer low flow period, increased summer temperature, affecting streams and pooled water, and reduced forest cover.	H→H? in temperature sensitive[d] watersheds (similar in other watersheds) because water temperature highly correlated with air temperature.	**Practices** Retain riparian cover. Improve riparian practices. Manage warm-water sources (e.g., road ditches). **Monitoring** Monitor air temp., stream temp., precip., and flow. **Planning** Classify temperature sensitive watersheds. Increase riparian management standards. Identify sites that feed water to streams. Determine aquifer volumes.
Spawning bed quality ↓ due to bed load movement when eggs in stream, and increased sedimentation.	H→MH	**Practices** Decrease road density. Replace culverts with bridges. **Monitoring** Road review (e.g., assess bridges, culverts, ditches, stream crossing quality index). Condition of high value spawning areas. **Planning** Identify "flashy" watersheds and plan accordingly.
Overland flow ↑ due to reduced forest cover (ECA ↓) from increased natural disturbance and reduced permeability following fire.	L→L	No management response. **Monitoring** Post-fire erosion hazard.
Peak flow ↑ due to increased rain on snow events.	MH→M in western mountains. LM in eastern plateau.	**Practices** Retain 30-50% of THLB in hydrological greenup in western mountains. **Monitoring** ECA. Road density. Burned areas on eastern plateau. **Planning** Determine appropriate management practices for each watershed (Watershed Assessment Procedure).
Flood risk ↑ (but uncertain) due to increased climatic variability creating large snowpacks that melt rapidly.	L→L	**Practices** Improved drainage structures and maintenance. Replace old culverts; use more bridges. **Monitoring**

Ecological Change[a]	Initial sensitivity by site/region[b] and potential management influence[c]	Management Response
Potentially increased flows in winter (due to rain on snow) but decreased spring flooding		ECA. Road review. **Planning** Watershed Assessment Procedure.
Landslides and surface erosion ↑ Currently roads cause 99% in interior and 50% on coast.	LM→L in western mountains. LM→L in eastern plateau.	**Practices** Surface high-hazard roads. Control erosion and sediment using grass seeding, surfacing and suitable ditches. **Monitor** Erosion, slides, deep-seated earth flows.

[a]Columns 1 and 2 are based on the hydrological workshop, November 2010, and on modifications from this workshop.
[b]Sensitivity (most likely magnitude of change over the next 50 to 100 yr): Low, Low-Mod, Mod, Mod-High, High.
[c]Magnitude of influence shown as shift in sensitivity due to all management actions (e.g., High → Mod).
[d]Temperature sensitivity based on physical characteristics of watershed (e.g., aspect) and values present (e.g., fish species).

Table 4. Management responses to changes in hydrological/aquatic ecosystem services.

Ecosystem Service Change[a]	Initial sensitivity[b] and potential management influence[c]	Management Response
Increased risk to fish	H→M	**Practices** Reduce fishing pressure. Manage access to fish. **Monitoring** Fish population. **Planning** Integrated inland-offshore fisheries management.
Increased risk to infrastructure due to increased peak flow.	L→L	**Practices** Have already been replacing susceptible bridges and culverts. Will continue to look for susceptible culverts and other structures. Over next 50 yrs will replace structures/bridges which can be upgraded to climate-appropriate standards. **Monitoring** Road review.
Increased risk to infrastructure due to decreased slope stability.	L	None.

[a,b,c]See footnotes from table above.

Biodiversity

We use a coarse filter approach for describing impacts to biodiversity and developing adaptation responses. Coarse filter approaches typically consider the amount and pattern of seral stages by representative ecosystem types (e.g., site series). For the purpose of assessing impacts of climate change, it is also useful to consider microclimatic conditions. Thus, habitat requirements can be divided into three components:

- suitable seral stage (structure), affected by increased disturbance due to climate change and by harvesting;
- suitable ecosystem type (soil moisture and nutrients which influence plant communities); moisture is affected by precipitation and evapotranspiration which are affected by macroclimate and forest cover; nutrients will change relatively slowly as macroclimate changes and disturbance increases;
- suitable microclimate (i.e., at the scale of the species, e.g., microclimate for understory plants), affected by macroclimate and forest cover; because of forest cover, established communities are less exposed to macroclimate and face less risk from climate change.

Species are influenced directly and indirectly by habitat. Direct influences include, for example, suitable temperatures, moisture, substrates and nesting sites. Indirect effects include, for example, changes in prey, competition, predation and parasitism.

Plant and animal communities vary by microclimate, site type and seral stage. Changes to habitat have secondary effects on competition, prey, predation, parasitism, etc. Initial climate-induced changes in plant communities will reflect reduced vigour (and in cases where tolerances are exceeded, extirpation) of some specialist species and increased competition from generalists and invasive species. Over the longer term, immigration of species better suited to the microclimate and site will further restructure the plant community, provided the climate stabilizes.

Old forest is the seral stage most at risk from climate change. Some species prefer old forest, and need a minimum amount to flourish. Old forest connectivity facilitates emigration and immigration over longer time periods. Emigration allows Nadina species to move to avoid extinction. Immigration brings climatically-suited species to the Nadina and rebuilds diverse communities, improving ecosystem function over the long term.

Participants in the biodiversity breakout group identified management responses to specific ecological changes (Table 5) and to changes in ecosystem services (Table 6). They also outlined a general management response for biodiversity as follows.

General practices include

- increasing diversity at stand and landscape scales (i.e., a bet-hedging strategy; also, diversity begets diversity);

- increasing the area of reserves, wildlife tree patches (and riparian buffers), and partial retention cuts;
- increasing un-roaded area.

General monitoring includes
- clarifying ecological sensitivities to climate change (currently very rough estimates);
- identifying unidentified high risk sites (e.g., alpine);
- experimenting with a wide variety of new practices to obtain feedback.

General planning includes
- incorporating ecological function and biodiversity conservation issues at all planning tables (community, agriculture, energy, etc.).

Table 5. Management responses to ecological changes that affect biodiversity.

	Ecological Change[a]	Initial sensitivity[b] by site/region and potential management influence[c]	Management Response
	Habitat		
1	Suitable microclimate and soil conditions[d] ↓	H→M in bogs. MH→LM in dry sites. LM→LM for mesic to moist sites. L to H → L to LM in hydroriparian (i.e., varies by stream size, grade).	**Practices** Avoid harvesting bogs and dry sites to maintain stand inertia[e]. Retain climate-resistant refugia (e.g., larger riparian buffers). Retain overstory to provide shelter. Retain down wood to retain moisture. Plant climatically-suited species and genotypes (facilitated migration) where transformation best option. Promote early seral species diversity. **Monitoring** Permanent plots. **Planning** Moisture models.
2	Disturbance ↑[f] Old forest ↓ Mixed-age forest ↑	H→M in SBS. MH→LM in ESSF.	**Practices** Increase area of reserves to account for increased natural disturbance: reduce green and salvage harvest. Maintain disturbance-resistant refugia (e.g., riparian). Partial cut/salvage selectively: avoid salvaging stands that buffer microclimate and provide valuable (e.g., large) structure. Promote rapid recovery (e.g., rapid reforestation). Reduce susceptibility to disturbance (questionable effectiveness). **Monitoring** Insects and disease trends. Fire hazard trend.
3	Old forest connectivity ↓	H in upland and M in hydroriparian → LM overall.	**Practices** Create a network of reserves and corridors. Retain a “percolating” landscape pattern.

	Ecological Change[a]	Initial sensitivity[b] by site/region and potential management influence[c]	Management Response
			Avoid salvaging in corridors where connectivity impacted. Integrate with responses to #1 and #2.
	Species interactions		
4	Risk to specialized species[g] and communities ↑	MH→LM.	**Practices** Boreal: create refugia on low-nutrient sites. Alpine/subalpine: remove encroaching trees. Water associated communities: see response to # 1. Old forest associated communities: see response to #2. **Monitoring** Study effects of snowpack on plants and trees.
5	Altered successional pathways	LM→L for trees.	**Practices** Accept if hard to change and risk to biodiversity low (e.g., increased brush or deciduous trees). Alternative silviculture to promote desired path. Alter species composition at planting. Increase species diversity and successional options. Stand tending (e.g., brush control).
6	Invasive species ↑ (e.g., hawkweed)	H→H in SBSdk. MH→M in SBSmc. M→L in ESSF and BAFA.	**Practices** Minimize site disturbance, particularly multiple disturbances. Minimize roads; seed roadsides, control access. Control grazing. Early detection (monitoring) and pesticide control. Maintain cover on susceptible sites. SBSdk is a lost cause.

[a]Columns 1 and 2 are based on the biodiversity workshop, Nov. 2010, and on modifications from this workshop.
[b]Sensitivity (most likely magnitude of change over the next 50 to 100 yr): Low, Low-Mod, Mod, Mod-High, High.
[c]Magnitude of influence shown as shift in sensitivity due to all management actions (e.g., High → Mod).
[d]Maladaptation of species to a site is conceptually similar to habitat deterioration (or loss); this table combines microclimate and soil conditions.
[e]"Inertia" indicates that a stand has already passed the most challenging regeneration (start-up) phase and is able to better tolerate climate change (i.e., keep going).
[f]See Trees and timber section for responses to specific disturbance agents.
[g]Risk to specialized plants may be higher than risk to specialized animals due to the relatively limited dispersal ability of the former.

Table 6. Management responses to changes in biodiversity-related ecosystem services.

Ecosystem Service Change[a]	Initial sensitivity[b] and potential management influence[c]	Management Response
Simplified communities ↑	MH→M	**Practices** Promote diversity in management at all scales. Protect special communities at risk. Control competition. Actively restore degraded communities. **Monitoring** Permanent plots.

Ecosystem Service Change[a]	Initial sensitivity[b] and potential management influence[c]	Management Response
Extirpation ↑	H→H	**Practices** Management at this stage is costly and of uncertain value. Focus on habitat and demography. Use fine-filter approaches. Assisted migration. Ex-situ conservation. **Monitoring** ID habitat of species at risk. **Planning** Better models of magnitude of climate-induced change. Identify species at risk based on life history, across BC.
Ecological function/ resilience ↓	M→ML	**Practices** Goal: maintain functional redundancy at stand and landscape scale Use best practices for biodiversity conservation. Promote diversity of species and seral stages over a representative range of ecosystem types. **Planning** Bring ecological function and biodiversity conservation issues to all planning tables (community, agriculture, energy, etc.).

[a,b,c]See footnotes from table above.

Barriers to adaptation

This plenary session asked what prevents adaptation?

Climate change adaptation is an investment in forest resilience that serves future generations. For investment to occur, three key questions must be addressed:

- Who pays?
- Who takes on the risk?
- Who benefits?

In BC's forests, these questions do not have simple answers because responsibility for forest management is fragmented:

- <u>between government and industry</u>
  Investments in non-timber values do not bring a payoff to licensees. Government and licensees share timber-related benefits through license agreements; government, other resource users and the general public share non-timber benefits. Costs and risks should align with benefits.

  There is little certainty that long-term, timber-related investments will benefit the licensee because tenure agreements and assigned operating areas may change over a rotation. Without an expectation of benefit, there is little incentive for licensees to pay up front or take on risk. Even with more secure future benefits, economic discounting of far-future benefits will limit private sector investment.

- among licensees operating in the same area
  Multiple licensees in multiple sectors complicate planning for a particular area. Planning is difficult to coordinate and cumulative effects are difficult to calculate. Where conservation targets are set over an area managed by multiple licensees, one licensees contribution to a seral stage target, for example, reduces the obligation of another—a classic tragedy of the commons. This problem may be largely addressed by explicit advance planning.

- over time
  For example, the responsibility for stand health passes from licensees to government when a stand reaches free growing status. Some adaptation strategies can increase risk to a company. For example, a climatically-suited species such as Douglas-fir can take longer to reach free-growing status than pine, which rapidly reaches free growing status and relieves licensees of reforestation obligations. Paradoxically, climatically-suited species that have a better chance of reaching rotation age may still increase risk to licensees if they take longer to become free growing.

The appraisal system pushes practices towards the least-cost acceptable standard. It determines stumpage charges in part by considering the average costs of specific operations (e.g., planting). Any climate change adaptation measures that cost more than average become a direct cost to the licensee. For example, the tenure system pushes the species composition of stands towards species that are cheapest to plant.

Large scale socio-economic context can also create barriers. Market demand may run counter to adaptation measures, for example, by favouring species that are becoming less climatically suitable. The Softwood Lumber Agreement and related trade pressures may make the province less willing to invest in adaptation measures because they could be viewed as subsidies. Limited public awareness of the need to adapt to climate change leads to limited political interest.

Specific highly relevant barriers to reforestation include

- Chief foresters seed standards that do not allow experimentation with southern seed sources.
- Free growing standards that promote historic planting practices: although alternatives are allowed, licensees must make an effort to get new species approved and must take on risk of failing to meet free growing status and associated replanting costs

Options for moving forward

This plenary session asked what steps the workshop participants could take to promote climate change adaptation. While most responses related to funding, problems related to multiple licensees and structural disincentives for innovation need to be addressed also.

Building on sustainable forest management plans with federal collaboration

It may be possible to incorporate climate change adaptation measures into the Sustainable Forest Management (SFM) planning process.

The Innovative Forest Practices Agreement (IFPA), a partnership of licensees in the Nadina District, has spent several years developing a SFM plan as part of the process of certifying their wood products under the Canadian Standards Association (CSA). This planning process, which has developed planning and monitoring capacity, provides useful experience for tackling climate change. The SFM plan includes indicators for multiple resource values which could be readily modified and expanded to address climate change.

The CSA defines the scope of SFM plans with a set of criteria and indicators relevant to a range of ecological and social values. The CSA adopted criteria and indicators developed by the Canadian Council of Forest Ministers (CCFM). The CCFM is currently preparing criteria and indicators for climate change. Whether or not these indicators will also be adopted by the CSA is unclear, however, new climate change criteria and indicators should be compatible with the CSA criteria and indicators.

The CCFM is interested in testing its new climate change vulnerability assessment methodology. The Morice TSA has been proposed as a pilot for evaluating the CCFM's climate change adaptation framework

Influencing provincial funding

Funding of climate-change related projects is currently lacking. Stable, long-term funding is required (e.g., a Trust) to address climate change, but is notoriously difficult to secure. Funding for forest investment varies with political and economic forces.

Messages from the forest management community highlighting the importance of addressing climate change might influence the provincial government to fund/support climate change adaptation. Several climate change vulnerability assessments are underway in BC. If some forest managers from each group argued for more provincial support for climate-change adaptation, the message may be more influential.

The Union of BC Municipalities has become a more powerful group over the last decade. In theory, each community has a vested interest in local adaptation and may join the call for increased provincial support.

Some felt that only broadly-based public pressure would encourage the provincial government to fund or otherwise support climate change adaptation projects.

Appendix 1. Letter from Office of Wet'suwet'en.

Postal Address:
205 Beaver Road, Suite 1
Smithers, BC
V0J 2N1

Telephone: (250) 847-3630

OFFICE OF THE WET'SUWET'EN

www.wetsuweten.com

Location Address:
3873 – 1st Avenue
Smithers, BC
Canada

Facsimile: (250) 847-5381

April 8, 2011

Wet'suwet'en Input for:
Nadina Climate Change Workshop

A lack of collaborative planning among all forest licence holders has created a haphazard mosaic of forest plantations (tree farms). As more than half of the Timber Harvest Land Base has been extracted and/ or impacted by MPB, it is evermore important to be thinking about long-term ecosystem health and integrity. Our forests are not only an economic resource, but a source of health and well-being of our communities.

We must realize that forest plantations do not and will not represent natural forest ecosystems. Natural structure and function of ecosystems is the source of ecosystem resilience. Hence there is an increasing need to plan and manage for ecosystem corridors, as these may be the seed banks for the future. A potential solution is to modify the Forest and Range Practice Act to require larger buffers around all streams and riparian areas.

This will not only provide for increased biodiversity, but mitigate hydrological change and help control stream temperature increases that impact salmon production.

From our perspective current Land Resource Management Plans (LRMP's) favor forest licencee's and other economic drivers. A balance must be achieved which also recognizes ecosystem, social and cultural needs of the future. This is not to say that economic activities must cease, rather they need to be done smarter and corporate shareholders need to accept that lower financial returns are not a loss but an investment into the future.

Current legislation regarding Stocking Standards and Free to Grow requirements influence forest licence holders to manipulate the early seral (herb/ shrubs) stage to transition to fiber production as quick as possible. These practices do reduce

"We are proud, progressive Wet'suwet'en, dedicated to the preservation and enhancement of our culture, traditions and territories, working as one for the betterment of all."

biodiversity and effect hydrology. Our future forests need to be seen as more than just tree farms, they also provide food resources. The fitness and diversity of an ecosystem will determine its resilience.

A tolerance for "competitive brush species" will increase the biodiversity on the land base, contribute to the organics in the soil, fix nitrogen and continue to provide forage. The herbaceous layer is also a source of food and medicine for First Nations.

Agro-forestry may be an avenue to explore for the future. Our forests are able to provide annual crops of food for the long-term, which will provide some jobs while we wait 80-120 years for tree farms to mature. It may be useful to utilize the Northern Interior Vegetation Management Association (NIVMA) and their data to develop feasibility data of food production in addition to fiber production.

Current legislation is the greatest barrier to change. As more effects from climate change become apparent we will have to change our ways of thinking. Our actions today create the world our children will live in tomorrow.

Recognition of Aboriginal Rights and Title should not be feared by government or industry. It is a paradigm shift that is needed to facilitate positive change for the future. Working together for the betterment of all.

Appendix 2. Summary of email comments from Rick Heinrichs.

Integrated management of hydrology and biodiversity in hydroriparian areas[2]

Aquatic ecosystems and terrestrial ecosystems interact in hydroriparian areas, where water influences land and land influences water. Conserving hydroriparian areas benefits both hydrology/aquatic ecosystems and biodiversity, enhancing overall ecosystem resilience and helping to mitigate climate change. Over-representing hydroriparian areas relative to other ecosystem types and applying best management practices[3] to hydroriparian areas may better maintain overall ecosystem resilience under climate change because hydroriparian areas provide multiple, important ecosystem functions:

- tend to provide the highest value terrestrial wildlife habitat in a given watershed;
- provide connectivity of forests that is reflective of natural disturbance patterns;
- provide large organic debris for aquatic habitat, stream bank stability, etc;
- mitigate stream warming by shading the stream and nearby shallow groundwater;
- mitigate watershed-scale hydrological impact (e.g., filtering sediment);
- provide some of the best carbon storage and sequestration sites in a given watershed (i.e., they are the most productive sites).

[2] This appendix is based on a post-workshop email from Rick Heinrichs, presenting an idea that he did not have time to raise at the workshop.
[3] Hoekstra, K. 2008. Ministry of Environment Morice LRMP best management practices: forest management of hydroriparian ecosystems. Report prepared for Ministry of Environment, Smithers, BC.