Appendix 5.4.11C
A Preliminary Assessment of the Mountain Pine Beetle Impact on Caribou Habitat Supply and Spatial Distribution for the Tweedsmuir – Entiako – Itcha-Ilgachuz Caribou Metapopulation

A Preliminary Assessment of the Mountain Pine Beetle Impact on Caribou Habitat Supply and Spatial Distribution for the Tweedsmuir – Entiako – Itcha-Ilgachuz Caribou Metapopulation

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For the

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INTRODUCTION

Caribou populations in BC have been under extensive scrutiny and concern since the year 2000, when they were blue listed (northern and boreal caribou) and red listed (mountain caribou) by the Conservation Data Centre. Similarly, COSEWIC designated Woodland Caribou within the SMNEA (Southern Mountains National Ecological Area) as nationally threatened in 2000. The federal government listed Woodland Caribou as a threatened species under Schedule 1 of the "Species at Risk Act" in 2003.

Unfortunately, very little action has transpired to correct the problems facing this species, in the ensuing 13 years. Although SARA initiated a recovery process in 2011, it took 3 years to actually initiate recovery planning (2014). However to date, "there is no published recovery strategy or action plan for threatened BC caribou" (McNay et al. 2013).

Overall, ALL caribou populations in BC have, are or will experience significant problems maintaining population sustainability. In 2004, (N. Caribou Tech Advis Comm), the population trend for 50% of the herds was unknown, 25% were declining and at that time 25% were supposedly stable. THE MAIN CHANGE SINCE THAT TIME IS THAT THE 25% THAT MAY HAVE BEEN STABLE ARE NOW VERY LIKELY IN A STATE OF DECLINE.

The Tweedsmuir – Itcha – Ilgachuz metapopulation, the largest, most significant, and the only actual genetically connected metapopulation, has declined by about 60%, based on actual counts, since about 2004 – 2006, and will decline even more dramatically in the future, if left unmanaged.

Throughout the province, several populations have fallen below levels where recovery is probable or even possible. Some populations could be recovered with significant changes in resource management regulations, political decisions and economic support, however, that is unlikely to happen. A few (with higher prioritized designations) could be sustained through immediate preventative, political and management actions.

THE TWEEDSMUIR – ITCHA – ILGACHUZ (T-I-I) METAPOPULATION LEADS THIS LATTER RANKING AND PROCESS, which could enhance its ability to maintain sustainability. It could be the best, last chance available.

There are probably few other species which have accumulated as many documents or as much of a paper trail and yet have remained in a threatened state. The opportunity to ensure the sustainability of the T-I-I metapopulation is dependent on positive action in the next 2 years. The recent proposed recovery strategy does an inadequate job of the recovery process and priorities and procrastinates even further by suggesting specific processes and programs should be identified and undertaken in the action plan.

IMPACTS

Documentation of the factors producing significant problems to populations and habitat, continue to identify consistent, similar piecemeal/cumulative attacks on both or either populations or critical habitat. These factors have been identified over and over again, since 2000, in a range of provincial documents.

In almost all cases, death by a thousand cuts produces the same consequences.

McNay et al. 2013 provide the most recent and complete listing of "activities that threaten destruction of critical habitat for caribou".

1.2.2 Examples of activities likely to result in destruction of critical habitat

Activities that threaten destruction of critical habitat for caribou include:

- *Disturbance to the components or ranges that detrimentally affect any requirements for life; and/or,*
- *Disturbance that leads to displacement from preferred ranges.*

Disturbance to components of range includes, but is not limited to:

- *Damage to and/or destruction of forage lichens (e.g., removal of terrestrial lichens during exploration activities and/or the construction of project infrastructure or removal of trees that provide support for arboreal lichens);*
- *Changes in snow interception and thermal cover due to changes in the forest canopy (e.g., removal of trees);*
- *Increased barriers to movement (i.e., two spatial scales are contemplated; loss of foraging habitat and/or isolation from other herds) that could result from project infrastructure (e.g., above ground pipes, intensively used roads, camp/plant facilities, fencing, reservoirs, berms, etc.) or portions of landscapes managed for other resource purposes (e.g., dense, even-aged forests of specific types and geographic position, agricultural areas, etc.); and,*

- *Loss of contiguous habitat for caribou to use.*

Range can also be altered detrimentally if changes lead to increased risk of mortality (e.g., alteration of matrix habitat adjacent to critical habitat that leads to abundant predators) or the inability for individual caribou to breed or raise their calves successfully due to the occurrence of anthropogenic activity that displaces caribou from their range. Potential threat factors and activities in the Action Plan area include:

- *Natural disturbances (e.g., fire, forest insects, avalanches) and climate change;*

- *Resource exploration and development activities (e.g., forest, minerals, coal, hydroelectric, wind power, and oil and gas – activities include use of helicopters, construction, and normal operation of onsite equipment and disturbances to land) during all stages of natural resource development (e.g., planning, exploration, construction, operations, reclamation, decommissioning, and ecological restoration);*
- *Recreational activities (e.g., snowmobiling, heli-skiing, all-terrain vehicles, hiking);*
- *Natural resource activities of non-First Nations (e.g., hunting, trapping, guide-outfitting);*
- *Habitat enhancement for other ungulate species;*
- *Settlements and agriculture, including the associated land uses (e.g., cattle grazing, residential housing, urban/rural amenities and services) and infrastructure (e.g., power lines, roads);*

- *Management to limit large natural disturbances and their effects (e.g., fire suppression, salvage harvesting); and,*
- *Development of roads and other linear infrastructure (e.g., utility and service lines, seismic lines, pipelines, railways) associated with management of the factors above.*

Table 3. Timing of threats by human activities on Klinse-Za herd life requisites.

Life Requisite	Threat	Fire	Mountain Pine Beetles (Epidemic)	Climate Change	Winter logging	Summer Logging	Oil and Gas Exploration	Oil and gas extraction	Mining exploration	Mineral extraction	Wind farms	Winter recreation	Summer recreation
Terrestrial lichens - forest	Reduction due to physical disturbance (including permanent structures)	SM[1]			SM	SM	SM	SML	SM	SML	SML	SM	SM
	Reduction due to increased competition from other vegetation in response to dead trees		S										
	Reduction due to increased competition resulting from increased site productivity			ML									
Terrestrial lichens – alpine	Reduction due to physical disturbance (including permanent structures)	SM					SM	SML	SM	SML	SML	SM	SM
	Reduction due to increased competition resulting from increased site productivity			ML									
Arboreal lichens	Reduction due to removal of trees	SM	M		SM	SM	SM	SML	SM	SML	SML		
	Increase due to increased ventilation and light		S										
Winter habitat	Displacement from high quality habitat during activities				S		S	SML	S	SML	SML	S	
	Potential displacement from high quality habitat due to habitat disturbance	SM	SM		SM	SM	SM	SML	SM	SML	SML		
	Loss of canopy for snow interception (travel, habitat selection)	SM	SM		SM	SM	SM	SML	SM	SML	SML		

Life Requisite	Threat	Fire	Mountain Pine Beetles (Epidemic)	Climate Change	Winter logging	Summer Logging	Oil and Gas Exploration	Oil and gas extraction	Mining exploration	Mineral extraction	Wind farms	Winter recreation	Summer recreation
	Blowdown/Coarse Woody Debris (travel, habitat selection)	M	M		S	S	SM		SM		SM		
	Potentially high density regenerating stands (travel)	ML		L	ML	ML	ML		ML				
	Potential use of plowed roads (travel)				S	S	S	SML	S	SML	SML		
Summer habitat	Displacement from high quality habitat during activities (noise, etc.)					S	S	SML	S	SML	SML		S
	Potential displacement from high quality habitat due to habitat disturbance	SM	SM		SM	SM	SM	SML	SM	SML	SML		
	Loss of canopy for thermal regulation (cooling)	SM	SM		SM	SM	SM	SML	SM	SML	SML		
	Blowdown/Coarse Woody Debris (travel, habitat selection)	M	M		S	S	SM		SM		SM		
	Potentially high density regenerating stands (travel)	ML		L	ML	ML	ML		ML				
	Use of roads (travel)				SM	SM	SM	SML	SM	SML	SML		
Migration	Displacement from high quality habitat during activities (noise, etc.)				S	S	S	SML	S	SML	SML		S
	Potential displacement from high quality habitat due to habitat disturbance	SM	SM		SM	SM	SM	SML	SM	SML	SML		
	Loss of canopy for snow interception (travel, habitat selection)	SM	SM		SM	SM	SM	SML	SM	SML	SML		

Life Requisite	Threat	Fire	Mountain Pine Beetles (Epidemic)	Climate Change	Winter logging	Summer Logging	Oil and Gas Exploration	Oil and gas extraction	Mining exploration	Mineral extraction	Wind farms	Winter recreation	Summer recreation
	Blowdown/Coarse Woody Debris (travel, habitat selection)	M	M		S	S	SM		SM		SM		
	Potentially high density regenerating stands (travel)	ML		L	ML	ML	ML		ML				
Calving success	Displacement from high quality calving habitat during activities					S	S	SML	S	SML	SML		S
	Displacement due to habitat disturbance in preferred habitats	SM	SM		SM	SM	SM	SML	SM	SML	SML		
Predator avoidance	Potential increase in moose forage resulting in potential increase in predators and predation risk	SM	SM	ML	SM	SM	SM	ML	SM	ML	L		
	Potential displacement to habitats with greater predation risk during activity				S	S	S	SML	S	SML	SML	S	S
	Potential displacement to habitats with greater predation risk due to habitat disturbance in preferred habitats	SM	SM	ML	SM	SM	SM	SML	SM	SML	SML		
	Increased predator efficiency due to roads/linear corridors				SM	SM	SM	SML	SM	SML	SML		
	Increased predator efficiency due to plowed roads/compacted trails				S		S	SML	S	SML	SML	SML	
Avoidance of other mortality risks	Potential displacement to habitats with greater risks of accidents (e.g. avalanches, falls) due to habitat disturbance in preferred habitat	SM	SM	ML	SM	SM	SM	SML	SM	SML	SML		

Life Requisite	Threat	Fire	Mountain Pine Beetles (Epidemic)	Climate Change	Winter logging	Summer Logging	Oil and Gas Exploration	Oil and gas extraction	Mining exploration	Mineral extraction	Wind farms	Winter recreation	Summer recreation
	Potential displacement to habitats with greater risks of accidents (e.g. avalanches, falls) during activities				S	S	S	SML	SM	SML	SML	S	S
	Increased vehicle collisions				SM	SM	S	SML	S	SML	SML		
	Increased mortality from hunting and poaching due to increased access				SM	SM	S	SML	S	SML	SML		
	Potential increase in parasites and diseases			ML									

[1] S=Short term, M=Mid term, L=Long term

Table 4. Threat ratings for the Klinse-Za herd population (from McNay and Hamilton in prep.).

	Threat	Impact	Scope	Severity	Timing
1	**Residential & commercial development**	**Low**	**Small**	**Extreme**	**Low**
1.1	Housing & urban areas	Low	Small	Extreme	Low
1.2	Commercial & industrial areas	Low	Small	Extreme	Low
1.3	Tourism & recreation areas	Low	Small	Slight	Low
2	**Agriculture & aquaculture**	**Low**	**Small**	**Slight**	
2.1	Annual & perennial non-timber crops	Low	Small	Slight	Low
2.2	Wood & pulp plantations				
2.3	Livestock farming & ranching	Low	Restricted	Moderate	Low
3	**Energy production & mining**	**Very High**	**Pervasive**	**Extreme**	
3.1	Oil & gas drilling	High	Pervasive	Serious	High
3.2	Mining & quarrying	High	Large	Extreme	High
3.3	Renewable energy	High	Large	Serious	Moderate
4	**Transportation & service corridors**	**High**	**Large**	**Serious**	
4.1	Roads & railroads	High	Large	Serious	High
4.2	Utility & service lines	Low	Restricted	Moderate	High
5	**Biological resource use**	**Medium**	**Large**	**Moderate**	
5.1	Hunting & collecting terrestrial animals	Low	Large	Slight	Low
5.2	Gathering terrestrial plants	Low	Small	Slight	Low
5.3	Logging & wood harvesting	Low	Restricted	Moderate	High
6	**Human intrusions & disturbance**	**Medium**	**Restricted**	**Serious**	
6.1	Recreational activities	Medium	Restricted	Serious	High
6.3	Work & other activities	Low	Restricted	Moderate	High
7	**Natural system modifications**	**Low**	**Restricted**	**Moderate**	
7.1	Fire & fire suppression	Low	Restricted	Moderate	Moderate
7.2	Dams & water management /use	Low	Small	Extreme - Serious	High
7.3	Other ecosystem modifications	Low	Restricted	Moderate	High
8	**Invasive & other problematic species & genes**	**High**	**Pervasive**	**Serious**	
8.1	Invasive non-native/alien species				
8.2	Problematic native species	High	Pervasive	Serious	High
9	**Pollution**				
10	**Geological events**	**Low**	**Small**	**Slight**	
10.3	Avalanches/landslides	Low	Small	Slight	Low
11	**Climate change & severe weather**	**Very High - High**	**Pervasive**	**Extreme - Serious**	
11.1	Habitat shifting & alteration	Very High - High	Pervasive	Extreme - Serious	Moderate
11.2	Droughts				
11.3	Temperature extremes	High	Pervasive	Unknown	Moderate

All activities may not affect each population or affect it to the same degrees and the timing, sequence and level of impact may differ, but the consequences of cumulative impacts on population and habitat decline are generally the same.

Although it may be somewhat enlightening for most people to review a long list of factors that impact caribou, THE REALITY IS THAT ONLY 4 OR 5 ARE OF SUFFICIENT PRIORITY, THAT THEY SHOULD BE IDENTIFIED AND IMPLEMENTED IN IMMEDIATE DEVELOPMENT OF AN ACTION PLAN.

PREDATION, HABITAT (MPB), LOGGING AND MINING.

Dealing with these cumulative factors immediately in an integrated fashion will solve 60 – 80% of the problem and will include the incorporation of many secondary factors.

The information for this document has been obtained from the series of strategy, management plans, prepared by the province from 2004 to 2013.

a) Northern caribou strategy, 2002. CCLUP Caribou Strat. Comm.
b) A strategy for the recovery of N. caribou in the southern Mountains National Ecological area, 2004. Northern caribou Tech. Advis. Comm.
c) Management options and related actions for Mt. Caribou in BC, 2006.Caribouo Reg. Mgmt. Team
d) A recovery action plan for N. caribou herds in North Central BC, 2008. McNay et al.
e) Management plans for the northern Mt. population of Woodland caribou, 2010. N. Mtn. Caribou Mgmt. Planning Team.
f) CCLUP northern caribou strategy review, 2011. CCLUP Caribou Strat. Comm.
g) Action plan for the Klin-se-za herd of Woodland caribou, 2013. McNay et al.

MANAGEMENT

Although information requirements for fine filter decision making will never be complete, the conclusions, measures, schedule, etc. are very similar for each of the above documents and for every herd. It is possible at this time to identify a range of multiscale factors, especially strategic components which have led to and currently lead to reasons for their threatened designation. It is possible at this time to:

1. Stratify the herds into groups based on opportunities for successful recovery
2. Identify coarse, medium and fine filter procedures for each group and for each herd within the top priority groups.

Identify a strategic scale which includes the main limiting factors to success:

1. The responsibility of the Federal government for 1st Nations but their lack of responsibility for the resources which support 1st Nations.
2. The responsibility of the Provincial government for management of natural resources but their lack of responsibility for real 1st Nations involvement in resource management.

Identify a process of political will and action to:

1. Conserve and protect wildlife resources utilized by 1st Nations
2. Provide a pathway for 1st Nation sustainability through a trade off process between conservation and economic development.
3. Secure the conservation of caribou and the sustainability of 1st Nations, especially the Ulkatcho Nation. In this case, it will not be recovered or resolved by any single agency, company, or government. It requires the commitment and cooperation of the following:
    - The Federal government
    - The Provincial government
    - Specific Ministries within the government
    - The Ulkatcho Nation
    - Cooperating 1st Nations
    - Several forest companies – West Chilcotin Forest Products, Canfor, West Fraser, Tolko BCTS
    - Several mining companies – Newgold, Amarc, RJK, etc.
    - Regional Districts
    - Municipal governments

Caribou population declines are the result of a range of multiscale cumulative effects (predation, MPB-habitat, logging, mining) that decimate habitat and population status. Therefore, recovery, success and sustainability will only result from a set of cumulative, cooperative endeavours. The silo mentality will have to be abandoned.

All documents identify the following: Since early 2000, Woodland Caribou (Rangifer tarandus caribou) have been identified as blue or red listed, nationally threatened, and threatened under Schedule 1 of the Species at Risk Act (SARA) and although recovery planning was initiated almost 3 years ago in BC, there is no published recovery strategy or action plan for these caribou (McNay et al. 2013). The main problem facing the T-I-I caribou metapopulation, the Ulkatcho Nation and even the SARA Recovery/Action is the inertia of the Provincial government in undergoing regulatory change.

CUMULATIVE EFFECTS

This document includes the land base for the Tweedsmuir – Itcha – Ilgachuz metapopulation which in large part lies within the Ulkatcho Nation Traditional Land Use Area. The above metapopulation is one of the only (or the only) caribou areas in the province where 4 sub-populations (& possibly a fifth) (Itcha – Ilagachuz, Tweedsmuir Rainbows, Charlotte Alplands and possibly the Entiako herd) can be shown to be genetically connected.

During the last decade, the T-I-I caribou metapopulation has been inundated and depressed by a range of mismanagement practices such as mountain pine beetle, wolves and industrial expansion. Wolf predation has significantly reduced both moose and caribou populations by 60%± and will continue to produce even more

significant declines. Mountain pine beetle has decimated western pine forests throughout the Chilcotin by up to 60%±. In addition, four recent wildfires have reduced both MPB killed forests and green stands by a significant amount. It is very likely that natural fires in this dry climate will destroy much of the remaining caribou habitat in the future.

It is ironic that even with this current state of depletion, Provincial regulation allows further degradation through the expansion of logging and mining operations. It is obvious, that in this situation, neither the Federal nor Provincial Environmental Assessment (EA) procedures are adequate to deal with these multiscalar, cumulative effects/problems. Most importantly, there is NO PROCESS TO DEAL WITH THE MANAGEMENT, AND ALLOCATION OF THE REMAINING 40% OF THE WEST CHILCOTIN FORESTS AND NO PROCESS TO DEAL WITH THE 60% MORTALITY AND ITS REHABILITATION. Industrial planning, both forestry and mining, are scale limited, generally utilizing operational scale procedures to deal with tactical and strategic problems. The EA process actually allows and condones mis-scale management by allowing operational mitigation procedures to replace strategic requirements.

Since the problem is multiscalar and multijurisdictional, yet the solution is piecemeal, and at the lowest, simplest scale, there is no apparent process to address a solution. Identifying the wide range of impacts affecting caribou, their habitat and aboriginal culture (McNay et al. 2013) is an obvious first step that has been identified many times since early 2000. But without political determination, commitment, funding, regulatory coordination and especially ACTION on a wide front, the result is clearly obvious and inevitable, FAILURE TO MAINTAIN CARIBOU.

RESOURCE MANAGEMENT

The wildlife resources in the Tweedsmuir – Itcha – Ilagchuz area are declining significantly, while the natural and man caused impacts have increased dramatically. The relationships between these changes are unclear and may be different from any other area in the province. Overall, however, the wildlife decline and relationship to the range of impacts, matches the situation in the remaining 32± caribou population in the province, which are also in severe trouble.

The Tweedsmuir – Itcha – Ilgachuz metapopulation is:

1. The largest population in the province
2. The only metapopulation that has been shown to be genetically connected
3. The main population which can be used as a transplant source to restore other provincial populations.
4. One of the main cultural and food sources for the Ulkatcho Nation.

The wildlife resources, moose and caribou, have been shown to have declined by 60±% over the last 5-7 years and are expected to continue to decline. Caribou cow-calf survival ratios and recruitment ratios appear to have declined by 95±%. Absolute calf mortality over that period approximates 3500 – 5000 calves, not including unknown adult mortality.

The Itcha – Ilgachuz caribou population, at its peak, numbered (actual counts) approximately 2800, but has since declined to ±1300 in 2010 and ±1100 in 2012. There was no calf production count in June 2013, and based on a

2012 fall calf survival ratio of 3.3/100 cows, the population must still be declining (possibly less than 1000 animals at this point).

At its peak, there were undoubtedly more caribou than moose in the area, at a higher land based density, and opposite to what normally occurs in moose – caribou situations. The moose and caribou declines occurred during the same time period, approximately (2003/2007 – 20013) and to about the same degree, leaving moose numbers at a very low level.

This situation has been compounded, unlike most areas of the province, by a large number of wide ranging cattle spread throughout the winter range over the summer and fall. Wolf predation on summer range cattle, especially calves, has been recounted by west Chilcotin ranchers for the past 5± years. Losses amount to $15,000-20,000/yr/rancher. Recently, a wolf radio collared east of the Itcha Mountains, approximately 1 year ago was killed west of the Itcha Mountains as a problem animal. Similarly a reliable rumour indicated that a second wolf collared east of the Itcha Mountains was killed in the vicinity of the Gang Ranch. These examples may indicate an extremely high density wolf population that is adjusting. Recently, a pack of 13 white wolves was observed east of the Itcha Mountains, suggesting northern genetic connections.

A preliminary wolf track inventory conducted by the Ulkatcho in 2013, suggested that there may be 200± wolves, north, east and south of the Itcha-Ilgachuz Mountains. In addition, approximately 50 were removed by Ulkatcho, west of the mountains in 2012 – 2013.

The large and complex supply of food biomass for wolves may suggest that declines in the wolf population and cycle may not be forthcoming in their “normal”, “natural” manner.

In the meantime, there appears to be no logical bottom to the caribou and moose population decline. Due to the extensive MPB outbreak, it is unclear what the new carrying capacity will be.

In any event, this unmeasured, uncontrolled decline is unnecessary in the face of mounting human impacts.

MULTISCALE STRATEGY

The Tweedsmuir – Itcha – Ilagchuz (T-I-I) metapopulation has undergone a major population decline (60%±) as well as a major decline in critical habitat (60%±). These declines have occurred almost simultaneously since about 2000 – 2006, but apparently occurred somewhat independently.

The population decline appears to largely result from predation, especially wolf predation, while the critical habitat decline resulted from extensive mountain pine beetle infestations and fire. The decline in habitat will eventually interact with uncontrolled wolf predation and possibly increase the rate of population decline and reduce carrying capacity for the entire area.

Coincidentally, both the population and habitat declines are being further affected by a set of cumulative effects created by industrial development and natural fires.

<u>Population</u>

There are two population scenarios:

1. The caribou population continues to decline due to wolf predation (2013 fall calf survival - 3.36 ca/100 cows)
2. Wolf control is implemented and the caribou population begins to stabilize and increase, reaching a new carrying capacity with the existing habitat (40% post MPB survival).

Habitat

The habitat scenario will change accordingly: the mountain pine beetle epidemic has run its course, significantly reducing the forested habitat by up to 60%, which will eventually reduce the arboreal food supply. At present, arboreal lichen supply is being maintained and is available. Terrestrial lichen supply within the forested habitat appears to have declined due to competition from kinnikinnick, but the terrestrial lichen supply within natural meadows appears relatively constant. At this point (2013) caribou are attempting to utilize similar areas that they used prior to the MPB outbreak. When that will change depends on the magnitude of the following ecological events.

In the near future, bark and branches from dead pine will be shed, removing the arboreal lichen supply. In addition, dead pine will begin to fall creating barriers to both arboreal lichen on standing, green pine and recovering terrestrial lichen communities.

RESULTS

1. If there is no wolf control, wolf predation may/will reduce the caribou population below the carrying capacity of the impacted habitat, rather than the level determined by habitat and/or disjunct habitat.

   At this point, the caribou population may not be able to recover & could disappear.

2. If wolf control is implemented, the caribou population will reach a new carrying capacity based on terrestrial lichen and availability of critical arboreal lichen.

   At this point, the limiting factors will be deep snow winters, lack of access to arboreal lichens in green standing pine and the reduced opportunity to obtain terrestrial lichen under pine canopies.

CUMULATIVE EFFECTS

In both cases, industrial and natural cumulative effects will add significant impacts to the remaining critical habitat.

Time Frame

The MPB epidemic will affect habitat, both arboreal and terrestrial lichen food supply, in various ways (supply, availability) for up to 80 to 100 years. The wolf predation impact will fluctuate with caribou population size, (and moose population size, as well as cattle availability) which is dependent on habitat carrying capacity.

The mining operations, both continued exploration and actual mines, with associated disturbance will affect the area for a minimum of 15 – 40± years. Although timber harvest is projected for 10± years, it could proceed

longer. At present there is no process to deal with the surviving 40 percent or the 60% mortality. An initial meeting with the Min. of Forests, G. MacDougall discussed planning options and initiatives.

Currently, four fires have occurred in the last few years. However, natural fires could expand dramatically, due to excessive fuel loading from dead MPB killed forests.

CONCLUSIONS

Without predation control and multiscale integration of industrial activities:

1. Caribou and moose populations could be significantly depressed for decades.
2. Caribou subpopulations could disappear.
3. The metapopulation connections could be broken and disappear entirely, similar to every other caribou population in BC.
4. The natural food supply for the Ulkatcho Nation could jeopardize the health and well being of many families.

The basic goal – objective – conclusion resulting from the series of cumulative effects over the past 10± years – MPB habitat loss, wolf predation , timber removal, fire, all mining activities, roads, hunting (and any I've missed) – is to maintain the T-I-I metapopulation at as high a level as possible, in order to maintain its ecological requirements and function – reproduction, survivability, exploration, distribution potential, population genetic exchange, etc. (Ad Hoc expert committee – D. Cichowski, Dr. D. Hebert, Dr. S. McNay, Dr. D. Seip, Dr. Kari Stuart Smith).

In order to accomplish the above population goal, multiscale procedures and solutions, political will, multi-government and agency cooperation and integration, multi agency funding, recognition of the long term productivity and carrying capacity of the land base and recognition of the Ulkatcho – cultural land base; must all be identified, integrated, shared and implemented.

ALTERNATIVE OPTIONS – MANAGEMENT FRAMEWORK

1. Control wolves
2. Maximize caribou populations to reach habitat carrying capacity resulting from natural and man caused impacts.
3. Modify forest harvest operations both layout and quantity removed. Address timber supply, management and allocation of the surviving 40% and rehabilitation of the 60% mortality.
4. Address multiscale activities and processes for all mining operations – operational, tactical, strategic.
5. Address fire potential.

If wolf control can be implemented, allowing the caribou population to be sustained at or near carrying capacity, the population may be able to maintain its biological requirements – reproduction, survival, exploration, population exchange, under the expansion of industrial impacts.

MITIGATION

1. A preliminary mitigation plan has been prepared by the Ulkatcho First Nations.
    a. Develop a wolf management plan to enhance caribou population size
    b. Transplant male caribou among subpopulations to maintain genetic diversity
    c. Develop a harvest plan with Canfor and possibly West Fraser (due to tenure exchange with Canfor), Tolko and BCTS, which prioritizes caribou habitat and migration corridors
    d. Integrate habitat suitability plans with habitat supply assessments, in order to prioritize caribou habitat requirements
    e. Integrate roads, road use and level of industrial activity
    f. Identify silvicultural programs accommodating natural and industrial impacts
    g. Identify indicators and monitoring programs and adaptive management strategies for caribou, moose and wolf populations (radio collars), natural phenomena (MPB, fires) and industrial activities.

    Etc.

With wolf control and caribou population recovery, the Ulkatcho Nation can determine and accommodate a conservation, economic multiscale plan. However, it requires a healthy and potentially sustainable caribou and moose population. The economic viability of West Chilcotin Forest Products, service contracts with Newgold and other potential mine development, as well as longer term agreements with Canfor, West Fraser, Tolko and BCTS will sustain the integration of conservation and economics.

CARIBOU HABITAT SUPPLY

Introduction

Forested caribou habitat supply and species proportions (pl-sp), changed significantly in the early period of 2000 – 2005, with the outbreak of mountain pine beetle in the West Chilcotin lodgepole pine forests. In addition, habitat supply also changed due to continued timber harvest operations prior to, during and following the mountain pine beetle (MPB) epidemic. More recently, habitat supply change also occurred from the application and expansion of mining leases, exploration and eventual mine development. Natural fires (4 in the last few years) and roads continue to deplete habitat supply.

The wide range of habitat impacts, affects both terrestrial and arboreal lichen food supply and subsequent carrying capacity. The habitat supply sequence resulting from MPB impacts and compounded by industrial development and fire can be assessed initially using a series of ecological successional stages: (Research into long term habitat supply, limiting factors and carrying capacity should begin now).

1. Mountain pine beetle epidemic: i.e. dead, living, percent, early age class species composition, distribution, spatial, temporal aspects/stages.
2. Post MPB epidemic continued mortality
3. Post MPB epidemic successional stages:
    a. Needle, bark and branch loss – arboreal lichen falldown – eventual depletion

b. Stem falldown – density – high and low site productivity forest locations, rates
c. Natural regeneration – density – high and low productivity forests
d. Fire – frequency, size, severity, location, composition
e. Current surviving forest – age, amount, species, location, size, juxtaposition, site productivity – Surviving forest allocation and timber supply
f. Logging – species, location, size, amount, density, site, productivity, surviving forest allocation.
g. Rehabilitation – type, species, site productivity, priority

Currently, habitat impacts and predation are interacting negatively to significantly reduce the Tweedsmuir – Itcha – Ilgachuz caribou metapopulation. In order to understand and assess caribou – habitat relationships throughout the period of cumulative effects, predation must be monitored, understood and very likely controlled, in order to maintain caribou at or near habitat impacted carrying capacity. In order to manage the many components of industrial impacts (amount, type, spatial temporal attributes, density, location, rate, etc.), habitat, including the surviving stable MPB component, and predation must be monitored under a SPECIFIC and PLANNED management program.

Spatial Methodology

The creation of the Caribou Habitat supply maps is based on utilizing various resource datasets in order to create a representation of the potential impacts on suitable habitat areas for the Northern Caribou herds.

In particular, the Ministry of Forests Vegetation Resource Inventory (VRI) data was analyzed and used in establishing two main classifications of suitable habitat.

The area of interest concentrated on the 1:250K scale map sheets 93C and 93F of the Chilcotin, Quesnel and Vanderhoof forest districts.

The following steps were performed in order to calculate the amount of area available for Pine and Spruce leading stands, taking into account the percentage classification estimates of live stands available, according to the information in the VRI datasets.

- Extracted all Pine leading stands with projected age => 50 years
- Extracted all Spruce leading stands with projected age => 30 years
- Calculate the area in ha. Of each VRI polygon occupied by the leading and secondary species based on the Species composition value in the VRI data
    - i.e. (a 100 ha. polygon with 90% pine and 10% spruce yields 90 ha. Pine and 10 ha. spruce).
    - Note: only primary and secondary species were considered and only pine and spruce.
- Using the “DEAD_PERCENT” attribute in the VRI data left in each polygon that contained live stems was calculated. (i.e. a 100 ;ha. Polygon with a “DEAD_PERCENT” value of 25 leaves 75 ha. Of live stands.)
- This calculation was used to calculate the area of Live Stands remaining in each polygon for each of the pine and spruce species.
    - In order to determine how much of each species was dead from the “DEAD_PERCENT” the “TOTAL_DEAD_VOLUME” attribute was looked at for the individual species. It was determined that nearly 100% of the dead volume was attributed to the Pine species only.

- Having determined the amount of area of Live stands for each species, the sums of the areas were calculated based on 20 classifications of 5% intervals with the results put into a table and displayed on the map.
    - (i.e. 0 – 5% live, 6 – 10% live…96 – 100% live)
- The resulting VRI data was themed based on the 20 classification units of the % live stands.

The boundary between the two map sheets contains an oddly shaped area, that is mainly green (higher survival) that can't be explained at this time.

Mountain Pine Beetle Assessment

The mountain pine beetle (MPB) epidemic spread throughout the West Chilcotin pine forests over the last 10± years. We assess the level of impact on map sheets 93F and 93C for

a. Mortality level and distribution
b. Survival level and distribution
c. Species effect
d. Identified early regen – pine < 50 yr, spruce < 30 yr
e. Moderate and high caribou suitability habitat in relation to the living and dead forest.

GIS Spatial Mapping Methodology

Maps

The following maps were produced in order to broadly identify:

a. Impact Type – mining lease map. Consolidated cutblocks.
b. Risk to caribou – Wildlife Habitat Harvest Zones – Timber harvest summary
c. Mountain Pine Beetle – Percentage Mortality – 2013
d. Mountain Pine Beetle – Percentage Mortality – Projection – 2023
e. Mountain Pine Beetle – Survival –Netted Down – Remove Non-Veg
f. Mountain Pine Beetle – Survival – Caribou Forest Harvest Zones
g. Immature Stands –pl< 50 yr. Sp < 30 yr.
h. Habitat Suitability – Newgold map
i. Mountain Pine Survival in relation to suitability rating map (h)

Survival and Mortality

The survival and mortality estimate maps are rough mirror images of each other. However, they differ slightly, because the mortality map does not have the non-vegetated portion netted out. They are simply broad representations of mortality and survival on the same land base, approximately.

Estimates of survival and mortality as a percentage will be calculated on estimates of the net land base (minus non-vegetated area and/or minus young age classes - < 50 yr pine and < 30 yr spruce) (Table 1.)

Removal of the non-vegetated component of the land base produces a net land base of 1,354,338 ha. on map sheet 93F (Table 1) and 1, 342, 119 on map sheet 93C. Assessment of pl and sp survival by polygon suggests that the magnitude of the MPB epidemic was approximately the same for each map sheet, 93F (500,660 ha.) and map sheet 93C (525, 881 ha.). Similarly, percent survival was similar: 93F – 36.97% and 93C – 39.29%. However, species survival differed greatly, probably resulting from different moisture, elevation and temperature regimes affecting the amount and distribution of sp. There appears to be a larger spruce component in map sheet 93F (278,055 ha vs. 106,952 ha), a higher living component (20.53% sp vs. 7.93% pl) following the MPB epidemic and a larger component in the younger age classes (< 30 yr Table. 1 (78,116 ha. vs. 802 ha.))(Table 1.)

Removal of the non-vegetated component and the young age classes, which appear not to be significantly affected by the MPB outbreak, leaves a net land base 1,075,779 ha. in map sheet 93F and 1, 324, 273 ha. in map sheet 93C. The survival rate increases to 46.54% for map sheet 93F and 39.71% for map sheet 93C. The difference results largely from a lower impact on the older age class sp stands and the larger number of stands from 1 – 3 years of age, possibly resulting from logging and fire.

Designation	**Map Sheet 93F**	**Map Sheet 93C**	**Total**
Base area of map sheet - ha	1,476,585	1,510,878	
Non-vegetated component - ha	122,247	168,759	
Net land base 1 - ha	1,354,338	1,342,119	
pl survival - ha	222,605	419,419	
sp survival - ha	278,055	106,462	
Total Survival - ha	500,660	525,881	
Percent survival 1	36.97%	39.18%	
By species pl	16.44%	31.25%	
By species sp	20.53%	7.93%	
			Total
Young age class			
< 50 yr pl	200,443	17,044	217,487
< 30 yr sp	78,116	802	78,918
Total young	278,559	17,846	
Percent occurrence			
By species pl	14.80%	1.27%	
By species sp	5.77%	0.06%	
Net land base (remove young age class)	1,075,779	1,324,273	
Percent survival 2	46.54%	39.71%	

Table 1. A description of the mountain pine beetle impacts on the amount and composition of forested caribou habitat in map sheets 93F and 93C.

Habitat Distribution

The MPB epidemic did not affect all areas to the same degree, especially and throughout map sheet 93C. The planning boundaries – park, no harvest zone, modified harvest zone and conventional harvest zone, have been added to map 9. It appears that there is a higher rate of survival in the southern portion of the modified harvest zone and possibly in the western and southern portion of the conventional harvest zone. There are a significant number of caribou locations throughout these zones.

It is especially important that the living stands be prioritized for caribou, as forest allocation partitioning procedures are undertaken.

Suitability and Critical Habitat

Currently, Newgold Inc. has initiated attempts to identify habitat suitability (map h) throughout their area of influence, utilizing standard procedures provided by the provincial government. Similarly, the federal recovery process is attempting to identify critical habitat, utilizing procedures from the boreal caribou recovery process.

Both mapping procedures have failed to identify the loss of arboreal and eventually terrestrial habitat due to the MPB epidemic and recent fires. The importance of drawing boundaries around supposed suitable and critical habitat is outweighed by the change and loss of habitat created by MPB, as well as that of habitat supply, availability, quality, carrying capacity, within the boundary and the length of time over which the impact will occur.

As well, the entire process may be over whelmed by the continuation and expansion of wolf predation, industrial development and natural fires.

The suitability mapping by Newgold was enlarged to the same scale as the MPB living polygon/survival map so that a visual comparison would be more obvious (map h & i). The comparison suggests that most of the high and moderately high suitability areas have been inundated by MPB. Similarly, a large portion of the moderate suitability areas have been severely impacted. Thus, suitability must be redefined within the context of severely impacted and altered habitat. Estimates of the revised carrying capacity are not simply related to standard suitability mapping. In this case, it is questionable if suitability provides any indication of the current state of the habitat and may possibly only be useful for:

a. Setting priorities for post MPB surviving stands
b. Rehabilitation
c. Fire protection

Similarly, the SARA recovery process is attempting to use standard definitions of critical habitat to identify critical caribou areas. In this case standard definitions don't apply. It is most likely, that the 40 percent post MPB stand survival should all be designated critical habitat over an expanded area that equals the carrying capacity of the pre MPB forest.

Ecological Succession

In general, the Tweedsmuir – Itcha – Ilgachuz metapopulation utilizes both terrestrial and arboreal lichen, on a seasonal basis, based on amount, distribution and availability, through typical nomadic movement.

However, use of terrestrial lichen occurs over a large area, (varying annually and seasonally) in mild to moderate winters (as defined by snow depth < 20 – 24", snow hardness, crusting and penetrability). Arboreal lichen is used as well, but appears to be most important in moderate to severe winters (as defined by snow depth > 20 – 24", snow harness, crusting and penetrability). Terrestrial lichen appears to be more prevalent and abundant in lower site index pine forests (1980's site index classification – Cichowski, per comm.) and in low site index black spruce stands, often associated with wetlands (Cichowski, pers. Comm.). Arboreal lichen abundance and distribution appears to be related to moisture regimes, rather than site index, but also includes low site index spruce stands adjacent to wetlands.

Initial Conclusions

1. Although we tend to identify what appears to be specific requirements/attributes for caribou (most of the work in the last 20 – 30 years), we don't emphasize the large scale land base required to meet the wide range of environmental, climatic, habitat, topographical, predator protection, annual and seasonal variability that individual studies and measurements imply, especially at higher carrying capacity.

   Highly variable, nomadic movement (high and low use of Itcha Flats, use of Puntzi and Punky Creek, etc.) enhances survival, allowing populations to maintain themselves at as high a carrying capacity as possible, to sustain reproduction, migration, exploration and long term survival. Thus, the land base required to produce and sustain a population of 2000 – 3000 caribou has probably been significantly underestimated in the land use and caribou plans. Similarly, there is no plan for the Tweedsmuir herd and no integration with the Itcha – Ilgachuz herd.
2. We have a reasonable understanding of a range of attributes (annual, seasonal locations, high lichen areas, site index, species, age, density, etc.) that should allow us to identify, prioritize and plan the heavily disturbed habitat and its successional stage progression for the next 70 – 100 years.
3. The most important basic objective should be to maintain the population at as high a level as possible, to accommodate its critical needs in the face of wide spread industrial cumulative impacts.

The MPB habitat mapping identified some significant differences between the map areas. The black spruce sites along with more standing spruce (278,055 ha) appear to be more common on the Tweedsmuir – Entiako winter range than on the Itcha – Ilgachuz winter range (106,462 ha).

At this point, MPB mortality/survival distribution has not been correlated with site index designations, in order to prioritize lichen distribution and availability. Although Cichowski (pers. comm.) suggests a relationship between terrestrial lichens and low/poor site index (based on the 1980's site classification), she also suggests that the current methodology determining site index differs from the past system so that she could not compare site selection.

As the post MPB epidemic proceeds through a range of successional stages, the site classification – lichen type utilization pattern implications to caribou carrying capacity, can only be estimated, but should be assessed and measured, in order to set priorities.

a) Needle and Branch/Bark Loss

It is possible that the terrestrial lichen supply has been/or could be supplemented by branch and bark loss from dead, standing trees for a short period of time, maintaining the pattern of lichen utilization. It would not be unusual for caribou feeding behaviour to remain similar to the pre MPB period, due to similar winter severity and adequate lichen. It is also likely that a significantly lower caribou population (60 percent lower due to wolf predation) could retain traditional feeding behaviours, when the population is considerably below carrying capacity.
Goward thinks that arboreal lichen abundance should increase following MPB, until the trees (and possibly the branches fall on the ground). It is unclear how MPB might affect the supply of arboreal lichen in critical winters over a 10 – 40 year period. At some point, arboreal lichen supply will be solely dependent on the 40 percent portion of the forest that survived MPB, fire, logging and mining.

b) Falldown and Decay

Following needle and branch/bark loss, decay and falldown should occur over a period of 20 – 40± years, post MPB mortality. Falldown in drier, lower site index areas may be slower than in moister higher site index areas. Falldown may be slower in map sheet area 93-C than in the potentially cooler and moister map sheet 93-F.

Falldown could/will impede feeding behaviour and reduce terrestrial lichen availability at a time when arboreal lichens supply has also been potentially reduced significantly. At this point, wolf predation may continue to keep the metapopulation below habitat carrying capacity.

The level of impact from both needle and branch/bark loss, falldown, fires and increasing industrial development will depend on the level of predation and the severity of consecutive winters.

At this point, there are few, if any measured examples of this combination of spatial and temporal distribution/overlap and magnitude of these cumulative effects.

c) Regeneration

In lodgepole pine forests, natural regeneration is usually rapid and dense following fire. In the case of the MPB epidemic, the surface has been less disturbed and may retard seed regeneration for a longer period of time. In this case, higher site index areas may show the most retardation due to intact ground cover. Living stands juxtaposition should influence regeneration rate and density.

As a result, the regeneration pattern may be delayed, reducing the immediate restriction on terrestrial lichen, but lengthening the shortfall period when arboreal lichen is restricted.

It appears that the cumulative effect of the post MPB successional stages will overlap with the cumulative effects of timber harvest, mine development and mine recovery, most significantly between 10 – 15 years post MPB and 35 – 45 years post MPB (Fig. 1).

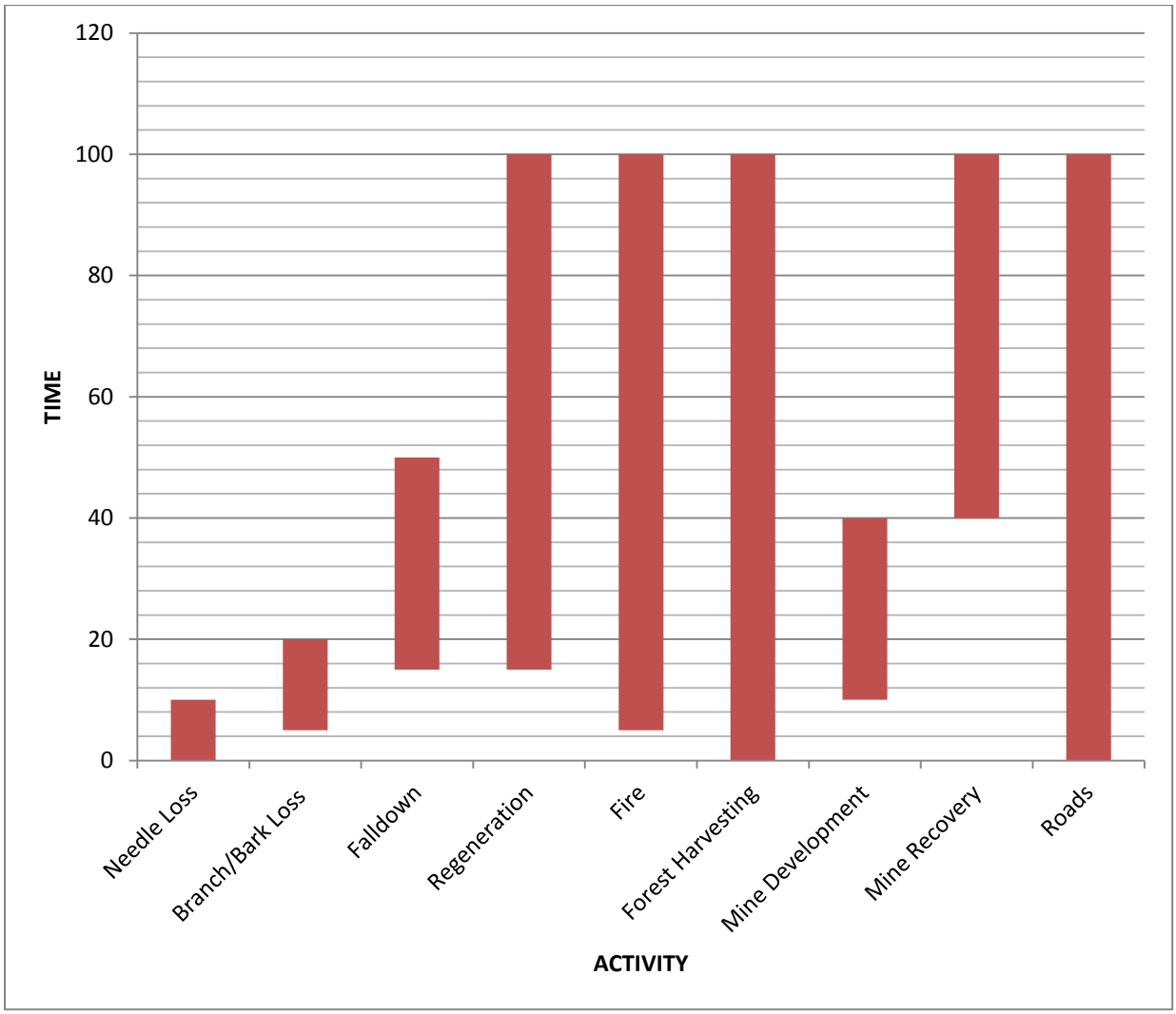

Figure 1. A temporal comparison of successional stage and industrial development.

d) Fire

At least 4 forest fires have occurred on critical caribou habitat in the last 5 – 6 years. Some of these fires have occurred within the corridor between the Tweedsmuir herd and the Ilgachuz herd. Others are simply removing dead trees and portions of the 40% post MPB surviving forests.

It is unclear how many, how big, or how frequent forest fires will occur and what portion of the cumulative effect they will eventually create.

e) Current Surviving Forests

Following the MPB epidemic, the West Chilcotin lodgepole pine forests are composed of the following:

i. Surviving pine leading stands (Total surviving pine (Pl leading, sp leading) = 642,024 ha or about 23.8% of the area (net land base 1).
ii. Surviving spruce leading stands (Total surviving spruce (sp leading, pl leading) = 384,517 ha or about 14.3% of the area (net land base).
iii. Early seral stands (< 50 yr pl and < 30 yr sp) that may be pine or spruce leading – approximately 278,559 ha of pl and 17,846 ha of sp).

The most important aspects of dealing with cumulative effects and MPB successional stages are:

i. The ability to assess habitat supply over a 100 year time frame
ii. The ability to identify the shortfall periods in habitat supply and the magnitude of the impact.
iii. The ability to identify a process that would partition the living forest through time and space, among the range of users – caribou, moose, forest harvesting and mine development impacts.

DISCUSSION WAS INITIATED WITH G. MACDOUGALL IN FEBRUARY 2014, REGARDING ALLOCATION AND INTER REGIONAL PLANNING OF THE SURVIVING FOREST LAND BASE. TO DATE, LITTLE OR NO PROGRESS HAS BEEN MAKE ON THE INTER REGIONAL PLANNING PROCESS!

f) Timber Harvest

The past and current management regime identified a management program that:

i. Provided some protection for the Itcha-Ilgachuz caribou in the form of a park, a surrounding no harvest zone, and a modified harvest zone.
ii. Although the Tweedsmuir caribou herd utilizes Tweedsmuir Park seasonally, a large part of its annual habitat use is outside the park where management procedures are inadequate to deal with its well being.
iii. Most importantly, there has been little or no consideration given to the metapopulation ecological and genetic requirements of these two integrated herds and their habitat.

    Similarly, the planning regime made no allowances for removal of 60± percent of the habitat due to MPB, and expanding fires and to the consequences of expanding wolf predation.

iv. A new, refined planning process is required immediately, to address the impacts from cumulative effects:
    - MPB
    - Wolf predation
    - Timber harvest
    - Fire
    - Mine exploration and development
    - Roads
    - Long term habitat supply

Carrying capacity and survival of this metapopulation, will depend on the creativity of individual management programs as well as the integration and tradeoffs among components.

TO DATE – NO ONE IN GOVERNMENT OR THE INDUSTRY HAS CONSIDERED OR ACTED ON ANY OF THE ABOVE IN A MEANINGFUL WAY.

g) Mining – The unknown additive effect

Currently there are 40 – 60 mining leases within or close to the corridor between the Tweedsmuir and the Itcha-Ilgachuz populations, as well as encompassing part of the seasonal ranges of the Tweedsmuir herd. As a result, Newgold Inc. has proposed one large mine site of unknown area and a second potential silver mine to the northwest.

Concomitantly, AMARC is exploring to the south and west of the Newgold claims and also has the potential of developing a mine in the centre of the inter-population corridor area.

The combination of three potentially large mines, with expanding road access could remove a significant portion of the remaining post MPB surviving forest. Removal of this habitat, plus the behavioural responses to road and mining activity could break the genetic connections between these two key populations.

The expanding cumulative effects must be addressed in relation to":

i. The objective of maintaining the T-I-I caribou population at as high a level as possible, in order to accommodate variability requirements, nomadic movement patterns, reproduction, migration, exploration and long term survival.

Discussion and Conclusions

Management Framework

Development of a management framework has been severely compromised by:

1. A 10 year delay in the development of a caribou recovery plan (SARA).
    a. A preliminary recovery plan which was rushed due to a pending court case.
    b. A preliminary recovery plan which did not adequately address the wide and extensive range of cumulative effects.
    c. A preliminary recovery plan which delayed any meaningful approaches to caribou management, to the development of an action plan.
    d. A preliminary recovery plan which did not address the requirement of the most important metapopulation in the province.
2. A set of outdated, inadequate land use plans and management policies, regulations and processes currently employed by the Provincial government.
3. An EA process that is not multiscale driven, is not inter regionally based and cannot address the complex range of cumulative effects at play in the West Chilcotin.
4. No inter regional coordination.
5. A significant lack of funding.
6. The inability of the Provincial government to deal with wolf predation.

Development of a management framework should be based on a sustainable framework for the West Chilcotin, which includes:

a) Sustainable wildlife populations: caribou, moose and predators
b) A sustainable Ulkatcho Nation – both ecological, cultural and economic.
c) A recognition of the Ulkatcho Traditional Land Use Area, by the federal and provincial governments as well as by industry, which addresses sharing and sustainability appropriately.

Development of a management framework, in the face of complex cumulative effects should be based on a sustainable goal/objective:

1. Maintain the caribou population at a sufficiently high level to protect and maintain its opportunity for reproduction, exploration, distribution, migration, nomadic self sustaining behaviour and its metapopulation status and function.

Maintenance of the self sustaining ecological parameters are dependent on:

a) Wolf inventory and management
b) Habitat supply assessment, habitat allocation and habitat management and rehabilitation.
c) An assessment of industrial cumulative effects and mitigation procedures and tradeoffs at a metapopulation level.
d) Since the problem is “death by a thousand cuts” (independent silos and management processes) the solution requires the complete integration of federal, provincial, Ulkatcho and industrial components. At this point the federal SARA and EA processes appear to be from two separate planets.

Habitat

The Tweedsmuir-Itcha-Ilgachuz metapopulation sustains itself through the use of terrestrial lichen over a range of average winters and with arboreal and terrestrial lichen during critical winter periods.

Since early 2000 the forested habitat and lichen producing land base has been severely impacted. Loss of 60% of the forest land base emphasizes protection of the remaining spruce component, especially in the Tweedsmuir area, the remaining mature pine and the young age classes of sp and pl which will contribute to the next stands of mature habitat.

It is unclear at this point how the MPB impact will affect the food source (both terrestrial and arboreal lichen) as well as the cover and predator protective components of contiguous habitat. Assessment of the successional stages of recovery are required, in order to develop appropriate management strategies.

An assessment of habitat carrying capacity will allow the determination of the level of predator control.

The important issues include:

1. A continued assessment of the components of habitat supply at each ecological stage
2. Improved research into habitat carrying capacity at each stage of ecological succession

3. A management and allocation plan which deals with the 40% surviving sp and pl.
   Sustainable carrying capacity for caribou may require all of the 40% surviving stands, especially the spruce.
4. A redefinition of habitat suitability and critical habitat and especially carrying capacity
5. A habitat rehabilitation plan based on potential habitat suitability potential critical habitat, the surviving sp and pl stands, which prioritizes the 60% mortality areas
6. A mitigation plan and fund to sustain the caribou population, manage wolves and manage habitat.
7. A research program that addresses many of the high priority habitat and population questions.