13 Appendices

Appendix 1: Terms of Reference

BRITISH COLUMBIA

Ste. 200 - 640 Borland St.
Williams Lake, British Columbia V2G 4T1
Telephone: (250) 398-4345

Inter Agency Management Committee

March 30, 1998

John Youds, Chair
Caribou Strategy Committee
c/o 400 - 640 Borland St
Williams Lake BC V2G 4T1

Dear John Youds:

The attached Terms of Reference for the Caribou Strategy Committee has been approved by the IAMC. The revisions to the earlier TOR reflect the results of the Integration process.

IAMC recognizes that the work that the committee is undertaking is extremely important and that the time frames for the completion of the various phases present some significant challenges. As indicated in the Terms of Reference, the IAMC Implementation Committee will be available to assist the committee.

We commend the committee for the work it has completed to date.

Yours truly,

Gyl Connaty
Acting Chair
Inter Agency Management Committee

attachment

cc: Implementation Committee

Caribou Strategy Committee Terms of Reference
Purpose: To address CCLUP requirements for integrated caribou habitat management.

1. Determine the research, inventory, ecosystem mapping and adaptive management work required to develop integrated management approaches for caribou habitat for Eastern and Itcha Ilgachuz caribou.
2. Ensure the initiation and completion of the appropriate research, inventory, ecosystem mapping, and adaptive management work.
3. Based on the above work and CCLUP and IAMC direction, develop integrated forest management approaches for Eastern and Itcha-Ilgachuz caribou which address CCLUP targets and implementation direction.
4. Based on the above work and CCLUP and IAMC direction, complete a preliminary identification of modified harvest areas for caribou which will address commitments to 2005 by June 30, 1998. This work will be refined annually and will form the basis for the subsequent years' Forest Development Plans, however it will only provide firm direction for the first two years of each FDP. Only minor changes in year 2 would be anticipated. Flexibility to incorporate further research results for years 3, 4, and 5 of the FDP will be maintained.
5. Based on the above work and CCLUP and IAMC direction, complete a caribou strategy which includes an identification of modified harvest areas for caribou by June 30, 2000. The research to support this work will be completed by December 31, 1999. It is likely that the research will continue after 1999 and that this work will be refined in subsequent years as a result.

Membership

MELP-Region
3 Wildlife and Habitat staff
MOF-District
2 staff

MOF-Region
1 Research 1 Planning

Other technical staff from MOF and MELP will work with the committee as required. Planners from BC Parks and BSBT will be kept informed and invited to work with the committee as needed.

See attachment #1

Administration

The committee selects or confirms its own chairperson annually. The current chairperson is John Youds, Regional Wildlife Biologist, Environment and Lands (January 1998).

The committee may choose to strike a caribou technical sub-committee.

Reporting

The Committee will report to the IAMC through the Implementation Committee or as requested by IAMC. Members of the Implementation Committee will work with the committee and where needed facilitate the work of the committee and ensure IAMC direction is provided to the committee. If any unresolvable disagreements arise they will be referred to IAMC.

All recommendations will be provided as drafts to the IAMC for their approval.

Technical involvement by stakeholders

The MLSC will be asked to provide a biologist to work with the committee and the technical sub-committee. The technical contact will not formally sit on the committee but will be expected to review information and provide input to committee and subcommittee members. Other stakeholders may also designate a technical contact.

Committee Mandate and Tasks

1. The committee will initiate and/or ensure completion of research, inventory and mapping projects required to develop integrated caribou habitat management strategies for Eastern and Itcha-Ilgachuz caribou populations. Within the context of the CCLUP and subsequent implementation direction, these strategies will attempt to develop the best options to maintain caribou habitat at the stand and landscape levels. The strategies will address the CCLUP requirements for modified harvest areas including the identification of 35% of the existing deferral areas for modified harvest.
2. The modified harvest areas will be selected to best maintain caribou values while taking into account timber values and making the best use of overlap opportunities to better meet all CCLUP targets. Opportunities for modified harvest in the 3 TSAs will be assessed. The 35% modified harvest and 65% no harvest areas will be identified on 1:20,000 scale maps.
3. The committee will identify operational management strategies, including stand level and landscape level recommendations, for Eastern and Itcha-Ilgachuz caribou.
4. The committee will develop and define modified harvesting for caribou habitat.
5. The committee will define portions of the caribou range which are sensitive to snowmobile use.

Products	**Target Dates**	
Input to STTAA	Short term	Completed
Interim Caribou Strategy	1995-1996	Completed
Updated Draft Identification of Modified Harvest Areas	June 1998	
Annual Progress Reports (to IAMC and RRB)	Annually in April	

Caribou Strategy (a) Itcha-Ilgachuz and (b) Eastern June 2000

- interim result of research and inventory to December 31, 1999, to be available for planning purposes

Analysis of research and inventory data completed by December 2000

(See Attachment #2; Workplan Timelines)

Appendix 2: IAMC Memo dated July 6, 1998

BRITISH COLUMBIA

July 6, 1998

File 204-20/IC/005

To: John Youds
Chairperson
Cariboo Strategy Committee

This letter is in response to your memo of June 23, 1998 regarding the application of Cariboo Chilcotin Land Use Plan (CCLUP) Itcha-Ilgachuz Caribou area based targets. The following is Cariboo Mid-Coast Inter-Agency Management Committee (IAMC) direction on the five issues raised in your memo.

1. The basis for the Itcha-Ilgachuz Caribou targets is the moderate risk option identified by the Western Caribou Working Group as modified by the CCLUP and the Integration Report. The CCLUP states "Based on the area which is currently proposed by the Western Caribou Working Committee for deferral under their moderate risk option, 65% of the forest land base deferred under this option has been assumed to be not available for harvest and the remaining 35% was assumed to be available under more sensitive harvesting practices." In addition, the moderate risk option includes modified harvest areas outside the deferral area. The map titled "Itcha-Ilgachuz Approved Integrated Management Areas" and dated June 8, 1995, defines the boundaries of the moderate risk option. This map, in conjunction with sub-unit boundaries, is to be used to determine the no-harvest and modified harvest areas by sub-unit. IAMC envisions some flexibility exists to adjust the distribution following an assessment of the impact on other targets and values.

2. As outlined above, the distribution of the target by sub-unit will be determined by overlaying the sub-unit boundaries on the moderate risk map.

3. See response #1.

4. It is IAMC's belief that some flexibility exists to shift portions of the no-harvest and modified harvest from areas within the moderate risk option area to areas outside within a sub-unit. Adjustments of this type must not negatively impact the achievement of other CCLUP targets and IAMC's evaluation of a recommendation of this type will include an assessment of its impact on achieving other targets.

5 IAMC also believes flexibility exists to shift portions of both the no-harvest and modified harvest areas between sub-units, again subject to the provision that this transfer of target between sub-units does not adversely affect the meeting of other CCLUP targets. The shifting of caribou management areas between sub-units has the potential to affect the target balance achieved in the Integration Report. The IAMC, in evaluating the overall recommendations as well as any

specific proposal to move caribou management area between sub-units, will determine if the proposal is consistent with the balance achieved in the Integration Report

I trust the above addresses the issues raised in your memo. Should you require further clarification please contact the Implementation Committee

Mike Carlson
IAMC Chair

Appendix 3: Managing for Natural-Disturbance-Seral-Distribution of older forest age classes within the Anahim Round Table Sub-regional Plan through balancing of the Equivalent Excluded Area associated with Northern Caribou target capital

Introduction

The Caribou Committee believes that managing for natural proportions of older forest age classes within identified Sub-boreal Pine Spruce (SBPS) biogeoclimatic (BEC) zone variants within the Anahim Round Table (ART) Sub-regional Plan (SRP) is more appropriate for caribou management than the prescriptions identified for the caribou modified-harvest area which is primarily within the Montane Spruce BEC zone. In order to meet the requirements of the CCLUP and balance the Equivalent Excluded Area (EEA) associated with identified caribou target within the ART SRP, the following procedure was developed. In brief it involved:

1. Considering natural proportions of age forest for Natural Disturbance Type (NDT)3 SBPS,
2. Calculating contribution of ART SRP constraints to meeting natural seral targets,
3. Calculating the EEA costs associated with the remaining natural seral targets,
4. Calculating the EEA cost associated with expansion of the 1998 Caribou modified-harvest polygon, and
5. Calculating the EEA capital available due to reduction in the 1998 caribou modified-harvest polygon.
6. Calculating the EEA capital available due to reduction in the 1998 caribou no-harvest polygon.

Procedure

1. Considering natural proportions of older forest age classes for SBPS NDT3.

Managing for natural proportions of age forest for NDT3 SBPS is expected to maintain caribou populations in the ART SRP area by allowing for some stands to grow to an age that will allow for terrestrial lichens to become abundant and provide foraging opportunities. The disturbance return interval for Biogeoclimatic Subzones are identified in the *Biodiversity Guidebook*, Table 10, Seral Stage definition for biogeoclimatic zones in NDT3 (see Table 1). Natural portions of forest age classes are defined in the *Biodiversity Guidebook* Table A4.2 Landscape percentage based on disturbance return interval (see Table 2). From Tables 1 and 2 the targets for natural proportions of age forest are inferred (Table 3).

Table 1. Mean event interval by biogeoclimatic zone in NDT3 (from Table 10 *Biodiversity Guidebook).*

Biogeoclimatic unit	Mean event interval (years)
SBPS	100

Table 2. Landscape percentage based on disturbance return interval (from Table A4.2 *Biodiversity Guidebook).*

Age (year)	Percent of Landscape (disturbance return interval of 100 years)
<20	18%
<40	33%
>80	45%
>100	37%
>120	30%
>140	25%
>250	8%

Target areas were calculated using the productive forest area (PFA) for all other resources (definition identified in Appendix 10, Integration Report) of a

specified Landscape Unit (LU)/BEC. The PFA is multiplied by the proportion (Table 3) to give an area for each target age. PFA and target areas for select ART LU SBPS variants are listed in Table 4.

Table 3. Modelling age and proportion.

Age (years)	Target age (years)	Proportion (%)
80-120	100	15
121-140	130	5
>140	140	25

2. Calculating contribution of ART SRP constraints to meeting natural seral targets.

Portions of the targets identified in Table 4 are met by other identified ART SRP constraints. All no-harvest constraints were assumed to contribute 100% to meeting the target for >140 years. Thus the target area for >140 years was reduced by the amount of the no-harvest identified in the ART SRP rollup analysis. No-harvest constraints identified in the ART SRP included the Dean River Corridor, Riparian Reserves, Class A Lakes, Trail Reserves, Riparian Top-up and Long-term Old Growth Management Area's (OGMA's).

Non-spatially defined wildlife tree patches (WTP) contribute a no-harvest amount to the ART SRP role-up analysis. In the role-up WTP no-harvest accounted for .68 percent of the ART SRP PFA. In this analysis, the >140 year target was reduced by 0.68 percent of the LU/BEC PFA.

Additionally, ART SRP constraints with a prescription age greater than one of the identified target ages was assumed to have a theoretical contribution to that target age. The formula for the theoretical contribution factor (TCf) follows:

TCf = 1-(TA/PA)
where: TCf = theoretical contribution factor
TA = target age
PA = prescription age

Prescription age is the time required, given ART SRP assumptions, to completely harvest a polygon under an associated constraint.

Prescription age is calculated as follows:
PA = (RA/(1-EEA)
where: PA = prescription age
RA = rotation age as defined by integration (pine = 80 years, other species = 120 years)
EEA = equivalent excluded area factor identified in ART SRP

Table 5 shows the TCf given pine forest, for various constraints identified in the ART SRP. Theoretical contribution factors are applied to the associated constraint area (at the LU/BEC level) identified in the ART SRP rollup analysis to give a theoretical

Table 4. Target area for identified Landscape Unit SBPS variants.

Landscape Unit	BEC Unit	PFA (ha)	140 yrs+ (ha)	121 – 140 yrs (ha)	80 - 120 yrs (ha)
Beeftrail	SBPSmc	4,537	1,134	227	681
Christenson Creek	SBPSmc	4,754	1,188	238	713
Hotnarko	SBPSxc	5,535	1,384	277	830
Telegraph	SBPSxc	9,280	2,320	464	1,392
Tusulko	SBPSmc	1,300	325	65	195
Tusulko	SBPSxc	9,174	2,294	459	1,376
Holtry	SBPSxc	15,670	3,917	783.5	2,351
Total		**50,250**	**12,562**	**2,313.5**	**7,538**

contribution area (TCA). The target area was reduced by the TCA.

As a result of managing for the >140 year target there is an additional non-spatial contribution to the 130 and 110 year targets. Given the 187 year rotation age associated with the 25% greater than 140 year target (see section 3) and an assumed equal age class distribution of this non-spatial constraint, a contribution equal to 1/187(difference in years that provided the target age)(area associated with >140 target). These areas are reduced from the 100 and 130 year targets. Table 6 indicates the target areas remaining after all reductions.

Table 5. Theoretical contribution factors for various ART modified-harvest constraints.

Prescription	Prescription Age RA/ (1-EEA)	EEA of Pine Stands	Theoretical Contribution to 140 yrs = (1-(140/PA)	Theoretical contribution to 130 yrs = (1- 130/PA)	Theoretical contribution to 100 yrs = (1-(100/PA)
Retention Visual	400.00	0.80	0.65	0.68	0.75
Class B Lake	200.00	0.60	0.30	0.35	0.50
NA	160.00	0.50	0.13	0.19	0.38
Caribou Modified	153.85	0.48	0.09	0.15	0.35
RMZ	106.67	0.25	0.00	0.00	0.06
Partial Retention	100.00	0.20	0.00	0.00	0.00

Table 6. EEA requirements to account for the net remaining target area not met by other constraints.

LU	BEC Unit SBPS	PFA (ha)	Remaining >140 yr Require-ment (ha)	Non-spatial Area Associated with remaining >140 requirement (remaining requirement/.25)	EEA Associated with Remaining 140 yr Requirement	Remaining 121-140 yr Requirement (ha)	Remaining 80-120 yr Requirement (ha)	EEA @ 130 (blended .36)	EEA @ 100 (blended .18)	EEA Sum
Beef-trail	mc	4537.4	345.1	1380.2	786.7	79.3	360.7	28.6	66.4	881.7
Christ. Creek	mc	4753.6	373.9	1495.5	852.5	77.7	382.8	28.0	70.4	950.9
Hot-narko	xc	5535.2	77.6	310.2	176.8	243.6	755.3	87.8	139.0	403.6
Tele-graph	xc	9279.8	267.8	1071.1	610.5	349.4	1147.1	126.0	211.1	947.6
Tusulko	mc	1299.7	39.4	157.5	89.8	48.1	156.8	17.4	28.8	136.0
Tusulko	xc	9174.4	790.3	3161.3	1801.9	120.6	663.5	43.5	122.1	1967.5
Holtry	xc	15670.0	1307.3	5229.2	2980.7	210.8	1075.5	76	197.9	3254.6
Total										**8,541.9**

3. Calculating the EEA costs associated with the remaining natural seral targets (Non-spatial area associated with remaining >140 requirement and related EEA calculations)

Within each LU/BEC with a remaining >140 year requirement there is an associated (non-spatial) area. As the remaining requirement is based on a 25% target, the associated area is 1/.25 or four times the remaining >140 year requirement area. To capture the 25% target, the associated area is managed with a prescription age of 140/.75 or 187 years.

Blended EEA is a method of area weighting the average EEA associated with pine and other species when combined. The ART SRP role up analysis found the pine/other ratio over approximately 90,000 ha was 92/8. As a result the blended EEA factor for a PA of 187 years is 0.57. The equivalent excluded area for the area associated with the remaining >140 target was calculated as 0.57(4)(remaining >140 year target).

As the targets for 100 and 130 years are average ages rather than a minimum, there was no additional associated area. The blended EEA for 100 and 130 years are 0.18 and 0.36 respectively.

Table 6 shows the remaining targets, the >140 year associated area and the EEA associated with the various targets.

4. Calculating the EEA cost associated with additions to the Caribou Modified-Harvest Polygon

New caribou modified-harvest polygon areas not previously identified have an EEA cost. In order to calculate the EEA associated with these new areas, each polygon was queried for PFA. This PFA was multiplied by the blended EEA factor for caribou (0.46) to give a base EEA for new caribou modified-harvest areas. The base EEA is net of all no-harvest constraints. From this base EEA, the EEA associated with other constraints ranked, in the ART SRP, below caribou modified-harvest was reduced. The calculations are summarized in Table 7.

5. Calculating the EEA capital available due to reductions in the caribou modified-harvest polygon

The EEA capital available for inclusion in the natural seral polygon is due to the elimination of portions of the caribou modified-harvest polygon. In order to calculate the EEA associated with these areas, the eliminated portion of the polygon was queried for the PFA of both pine and other species (note: as this area was identified in the ART SRP rollup analysis it could be queried for the amount of pine and other species; areas not previously identified could not be queried and had the blended EEA factor applied). The PFA of the pine and other species areas were multiplied by the EEA factors associated with the caribou modified-harvest polygon for pine and other species, respectively. The EEA was summed and then reduced by the EEA associated with Riparian Management Zones and Partial Retention Visual giving the net EEA capital available. Table 8 shows the PFA, EEA and associated reductions. Table 9 summarizes the calculations establishing the net EEA capital available due to the changes.

Table 7. EEA cost of expansion of the caribou modified-harvest zone

382.2	Additional EEA associated with 2002 caribou modified- harvest area not identified in the 1998 strategy (previously unconstrained)
4.8	Less riparian management zone identified in the ART SRP within new modified-harvest area
0.0	Less partial retention visual identified in the ART SRP
377.4	Net cost of expansion of modified harvest zone

6. Calculating the EEA capital available due to reduction of the Caribou No-Harvest Polygon (no-harvest to modified-harvest and no-harvest to conventional-harvest)

Further EEA capital was made available due to the conversion of portions of the no-harvest area into modified-harvest (see Table 10). In order to calculate the EEA associated with this conversion, the converted portion of the polygon was queried for the PFA. This area was then reduced by the PFA associated with other no-harvest prescriptions identified in the area through the ART SRP. The remaining area (695 ha.) was multiplied by 0.9 (the EEA associated with no-harvest in the ART SRP) to give the initial EEA for the converted polygon (625.5). The resultant area was also multiplied by the blended EEA associated with the modified-harvest polygon (0.46). The EEA associated with no-harvest was reduced by the EEA associated with modified-harvest to calculate the gross EEA associated with the conversion (305.8). The converted area was then checked for modified prescriptions that were ranked above caribou modified-harvest in the ART analysis. These modified prescriptions included Visual Retention and Class B Lake which did not exist in this conversion area. Thus the reduced gross EEA associated with the conversion became the net EEA capital associated with the conversion.

Additional EEA capital was available due to the conversion of portions of the caribou no-harvest polygon to conventional-harvest. In order to

Table 8. EEA Capital available due to reductions in the modified-harvest polygon by LU/BEC variant

Landscape Unit	BEC Variant	Caribou MH Pine Area (ha)	Pine EEA @ factor 0.48	Caribou MH Other Area (ha)	Other EEA @ factor 0.21	Total Caribou MH EEA Capital (Pine EEA + Other EEA) (ha)	RMZ Area	EEA RMZ @ factor 0.25 (ha)	PR Pine Area	EEA Visual PR @0.2 (ha)
Beeftrail	MS xv	105	50	0	0	50	10	2		
Beeftrail	SBPSmc	281	135	20	4	139	28	7		
Christenson Creek	ESSFxv	24		21						
Christenson Creek	MS xv	1,934	928	237	50	978	115	29	64	13
Christenson Creek	SBPSmc	1,126	540	285	60	600	43	11		
Christenson Creek	SBPSxc	234	112	29	6	118	32	8	10	2
Corkscrew	MS xv	1,042	500	472	99	599	72	18		
Holtry	MS xv	653	313	0	0	313	7	2		
Upper Dean	ESSFxv	5	2	0	0	2		0		
Upper Dean	MS xv	1,840	883	152	32	915	78	19		
Upper Dean	SBPSmc	9,047	4,343	1,458	306	4,649	666	166	19	4
Total						**8,365.4**		**262.8**		**14.8**

calculate the EEA associated with this conversion, the converted portion of the polygon was queried for the PFA. This area was reduced by the PFA associated with other no-harvest prescriptions identified in the area through the ART SRP. In the ART roll-up analysis caribou no-harvest was modelled above no-harvest constraints of OGMA and riparian top-up. No OGMA or riparian top-up constraints were identified in the area. The resultant area was multiplied by 0.9 (the EEA associated with no-harvest in the ART SRP) to give the initial EEA for the converted polygon. This gross EEA was then reduced by the EEA associated with all ART modified prescriptions.

Modified prescriptions mapped in this are were limited to WTP and RMZ. The net EEA factor associated with RMZ for this area was calculated as 0.9 (No-harvest EEA) less 0.25(RMZ EEA)= 0.65. Due to the method of analysis the net EEA was additional capital (see Table 11).

Table 9. Summary of EEA capital available due to the reduction in the modified-harvest area.

8,365.4	1998 Caribou MH EEA exclusive of 2000 MH areas
262.8	Less RMZ EEA nested below Caribou MH
14.8	Less Partial Retention visual EEA nested below RMZ
8,087.8	Net EEA Capital Associated with 1998-2001 Caribou Modified Harvest Changes

Table 10. Area associated with conversion of no-harvest to modified-harvest.

Landscape Unit	BEC Variant	PFA (No-Harvest to Modified-Harvest)
Christenson Creek	ESSFxv 1	20
Christenson Creek	MS xv	21
Upper Dean	MS xv	655
Total		**695 ha.**

As stated earlier non-spatially defined wildlife tree patches (WTP) contribute a no-harvest amount to the ART SRP role-up analysis. In the role-up WTP no-harvest accounted for .68% of the ART SRP PFA. For this polygon the PFA is multiplied by .68 to calculate the WTP EEA. WTP EEA was calculated as 669 ha X .0068 = 5 ha. The WTP EEA was reduced from the Total EEA capital mentioned above.
The net EEA capital associated with the no-harvest / conventional harvest conversion amounted to 592.6 hectares.

Summary

This lengthy and detailed analysis was undertaken to insure that refinements to caribou no-harvest and modified-harvest areas and the creation of the natural-disturbance-seral-distribution polygon did not create additional timber access constraints within the ART SRP. The analysis not only considered the shifting of caribou target but how

Table 11. EEA associated with conversion of no-harvest to conventional harvest.

Landscape Unit	BEC	Previous No Harvest PFA (ha)	Previous No-harvest EEA (@0.9)	RMZ area within No-harvest (ha)	Net RMZ EEA (No-harvest EEA - RMZ EEA = 0.9-0.25=0.65)	Total EEA capital
Christenson Creek	MS xv	51.7	46.5	1.6	1.0	
Upper Dean	MS xv	592.3	533.1	16.2	10.5	
Upper Dean	SBPSmc	7.2	6.5			
Total			**586.1**		**11.6**	**597.6**

those shifts in caribou target affected other constraints (i.e. visuals or OGMA's). The analysis utilized EEA estimates as the basis for measuring the costs and capital generated by the adjustments.

The following is a summary of the EEA costs associated with the changes:

NDSD Area	8541.9
Conventional to modified-harvest	377.4
Total EEA Cost	8919.3

A summary of EEA capital generated by the changes follows:

Modified to conventional-harvest	8087.8
No-harvest to modified-harvest	305.8
No-harvest to conventional	592.6
Total EEA Capital	8986.2

The adjustments resulted in slightly less cost created than capital generated (66.9 less EEA or a 0.75% difference). As a result the natural-disturbance-seral-distribution target area and other proposed changes are believed to be consistent with ART SRP modelling and analysis.

Appendix 4: Northern Caribou and Access Management

Caribou populations can only be maintained if all of the following issues are addressed together:

1. Maintaining suitable caribou habitat within existing caribou range
2. Limiting and regulating roaded and unroaded access in caribou habitat
3. Managing predation levels on caribou

Road construction to allow timber harvesting throughout much of the range of northern caribou will exacerbate access management issues. There will need to be concessions from all sectors that influence northern caribou negatively, including recreationalists, if caribou are to survive. This will mean creating separate zones for activities such as snowmobiling or other forms of motorized recreation so that these two land uses can co-exist.

Both Direct and Indirect Impacts Occur

An impact can be defined as an alteration, which may negatively or positively effect the environment, as a consequence of human land use or development activities (Shideler *et al*. 1986). Direct impacts are defined as those acting on the animals themselves while indirect impacts are those acting on the habitat, either by changing it or by disrupting the use of it by caribou or other wildlife species (Shideler *et al.* 1986). Direct impacts of linear developments can include the creation of physical barriers to movement or direct mortality due to vehicle collisions. Indirect impacts may occur through habitat loss, habitat alteration, habitat avoidance or improved access.

Concerns about improved access

In areas where ungulates are not hunted, animals may become less wary to the presence of humans (MacArthur et al 1982). Increasing access by way of developing a network of roads and packed trails throughout an animal's range, makes them more likely to be encountered by humans (Lyon 1984, Frederick 1991, O'Neil 1993). As a result, ungulates become more vulnerable to poaching and over-hunting.

Wolf predation, in particular, is often responsible for adult mortality and low calf survival in caribou populations (Gasaway et al 1983, Stevenson and Hatler 1985, Bergerud and Ballard 1988, Seip 1991,). Much of this mortality occurs during the summer and autumn seasons. Research has shown that wolves travel faster and are found closer than random locations to linear corridors (James and Stuart-Smith, 2000). During the winter months there is frequently minimal overlap between wolf and caribou winter ranges as moose are often the wolves primary prey and are often spatially separated from caribou. As such, snowmobile trail networks can provide new or improved mobility for predators to caribou winter range areas, which may increase predation rates, resulting in fewer animals (Neumann and Merriam 1972, Bloomfield 1979). This concern has been observed locally during a wolf survey undertaken in the west Chilcotin during the 1998-99 winter where extensive use of snowmobile trails by wolves was observed in the vicinity of Itcha Ilgachuz Provincial Park (Roorda and Dielman in prep.). Furthermore, reducing snowmobile numbers in a given area does not eliminate predator access to winter range as a result of established snowmobile trails.

Habitat Avoidance Issue

Caribou have been observed to use habitat close to roads and seismic lines less than expected (Dyer 1999,;James and Stuart-Smith 2000; Oberg 2001). Such avoidance patterns are thought to reduce the useable habitat for caribou. During late winter

(January -April) the alpine becomes the destination area for northern caribou where they concentrate on windswept ridges where terrestrial lichen is available as forage. In recent years, demands for subalpine and alpine recreational opportunities have increased throughout the province. Roads to high elevation cutblocks have resulted in increased recreational activity on caribou winter ranges throughout the Cariboo Region . Improved access along with increasing interest in recreational snowmobiling and more powerful machines that are able to traverse most caribou ranges may represent a threat equal to forestry-related habitat loss.

As a result of snowmobile activity, ungulates have been observed to abandon habitat, increase home range size or increase activity during normally inactive periods (Dorrance 1975, Eckstein et al 1979, Simpson 1987). Although caribou are known to shift between wintering areas during different years, locally, there is a large body of evidence accumulating that suggests that caribou are abandoning areas of preferred habitat within the Quesnel Highland due to increased snowmobile activity. Observations suggest that caribou may tolerate low levels of snowmobile use, but avoid areas of repeated high use. As a result of increased snowmobile activity throughout their range, it appears animals are being displaced out of their traditional areas. There is a concern that alternative areas may be poorer quality habitat where caribou are at higher risk to mortality. Also, displacement results in shrinking the amount of winter range available to caribou. When caribou are forced to occupy smaller range it is thought that there is a corresponding decrease in population levels. Similar concerns exist for caribou high elevation wintering areas in the Chilcotin.

Disturbance Issue

Snowmobile activity within ungulate winter range can increase the amount of energy expended when animals react to avoid close contact with machines and riders (Geist 1975). How animals respond and how much energy they expend depends on many factors (McLaren and Green 1985, Fancy and White 1986, Simpson 1987, Tyler 1991) including;

- the degree of previous harassment
- animal activity prior to disturbance
- snow depth and compaction
- visibility
- wind speed and direction, and
- topographic features

For ungulates in poor physical condition, or during particularly harsh winters, increased energy expenditure could seriously threaten winter survival.

How does wildlife respond to disturbance?

Wildlife exhibits a wide range of behaviour around people. Whittaker and Knight (1998) suggest that wildlife have developed situation-specific responses because some combination of learning and genetics has made them successful. In general wildlife responses can be grouped into three categories;

- attraction
- habituation, or
- avoidance

Gilbert (1989) suggests that an animal can find human provided stimuli reinforcing (leading to attraction), aversive (leading to avoidance), or neutral (leading to habituation). The consequences of wildlife responses are not always immediate, direct or obvious.

Why is disturbance of such concern?

It is generally recognized that most wild ungulates inhabiting the northern part of North America are in a negative energy balance during winter. As a result, severe or repeated human disturbance to ungulates could result in negative effects such as reduced growth rates, poor body condition or decreased reproductive rates, that may in turn reduce adult and calf survival rates (Webster 1997). Harassment may result in anything from slight increase in vigilance to panicked flight, with equally variable consequences to the animal (Jakimchuck 1980, Schideler et al 1986). Human activities such as hiking, snowmobiling, low altitude aircraft flights and All Terrain Vehicle use have all been shown to cause disturbance to wildlife (Webster 1997).

Why is there such a concern about snowmobiling in caribou range?

Simpson and Terry (2000) developed a conceptual framework that ranks the relative degree of threat from backcountry skiing, snowcat skiing, heli-skiing and snowmobiling to mountain caribou. Potential negative impacts were assumed to be greater for motorized activities as compared to non-motorized activities and assumed to increase as the size of the affected area increases. The very high magnitude of potential effects from snowmobiling is partly related to accessibility. As road access improves and expands over time, few areas will remain inaccessible to snowmobiling. Potential conflicts from other backcountry recreation activities are expected to occur over a smaller portion of caribou range.

Snowmobile activity in caribou winter range has the potential to influence animals in several ways;

- human use could displace northern caribou from preferred habitat with a resultant increased risk of mortality.
- packed trails could provide improved access for predators and poachers resulting in increased mortality.
- direct harassment would increase energy expenditure or risk of injury.

In summary, snowmobile use in ungulate winter range could cause the daily energy expenditure of ungulates to increase, wolf predation to rise or the displacement of animals from traditional range to occur.

Management principals for assessing and reducing outdoor recreation impacts on caribou

Although the effects of snowmobiling on various ungulates have been investigated, the scientific literature available on the impacts of snowmobile activity and human disturbance on caribou is incomplete. Thus the following principles where utilized to develop management guidelines to reduce potential impacts between caribou and snowmobiling.

Adaptive Management Principle - where scientific studies are lacking, adaptive management should be employed to develop scientifically supportable guidelines for outdoor recreation activities.

Environmental Stewardship – outdoor recreational activities must not impact environmental integrity, and only use land resources within their capacity to sustain use, while maintaining biological diversity.

Precautionary Principle – the precautionary principle, as applied to the impacts of outdoor recreational activities on wildlife means that where there are threats of serious or irreversible impacts to wildlife population viability, lack of full scientific certainty should not be used as a reason for postponing measures to regulate disturbance activities from motorized recreation.

Scientific Basis Principle – management guidelines for sustainable use of wildlife must be scientifically based, and supportable from available research or field studies. Where adequate scientific studies are lacking upon which to base management recommendations, interim recommendations should be based on a combination of best professional opinion and the precautionary principle.

Management Guidelines for Snowmobile Zoning within Northern Caribou Range

The regional caribou strategy committee recommend the following guidelines in an attempt to minimize conflicts between northern caribou and snowmobiling.

1. **At the landscape level, a few small, intensively used areas will have less impact on caribou than several large areas receiving moderate use.**
2. **Designated snowmobile areas should avoid high use caribou areas.** High elevation caribou wintering areas have been identified from radio-telemetry data and winter population surveys. These include the north side of the Itcha, Ilgachuz and Rainbow Mountains and the alpine area in the vicinity of Trumpeter mountain.
3. **Designated snowmobile areas should avoid Mountain Goat winter range.** These areas are very rugged terrain that also poses safety concerns to snowmobilers.
4. **To maximize use of designated snowmobile areas, they should be strategically located to ensure their accessibility from several communities.**
5. **Minimize the number of snowmobile trails to access high elevation riding areas through timbered no-harvest and modified-harvest areas as identified by the Regional Caribou Strategy.** These are considered high value caribou areas, where substantial compromise has already occurred through the Cariboo-Chilcotin Land Use Plan.
6. **Minimize the number of snowmobile trails through the timbered Natural Disturbance Seral Distribution polygon in the vicinity of Anahim Lake.** This area is considered high value caribou habitat, where substantial compromise has already occurred through the Cariboo-Chilcotin Land Use Plan.
7. **Where possible, snowmobile areas should be peripheral to caribou range.**

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Appendix 5: Risk Assessment Calculations (from Harper and Eastman 2000)

There is a need to provide a consistent and explicit basis for assessing risks so that management attention can be focused on the most critical issues. To provide this perspective, we adopted the risk assessment procedure used by the Compliance and Enforcement Branch (Ministry of Forests 1998). Initial risk assessment is based on two considerations: 1) the likelihood of a detrimental impact, and 2) the magnitude of the consequences. Given the lack of quantifiable assessments in the literature, qualitative judgments were used.

Initial risk assessment has the following steps:

1. identifying the detrimental impacts
2. estimating the likelihood of an adverse impact (rated as very high, high, moderate and low)
3. estimating the magnitude of the consequences of the impact, based on the impact and the intensity of an event (rated as very high, high, moderate and low)
4. combining the likelihood of impact with the magnitude of the impact to arrive an overall assessment of risk (rated as very high, high, moderate and low).

The table below presents the rating system applied in this report. The resulting assessment is a list of hazards or risks that is explicit and ranked.

LIKELIHOOD	X	MAGNITUDE	=	RISK*
Very High	X	Very High	=	Very High
Very High	X	High	=	Very High
High	X	Very High	=	Very High
High	X	High	=	Very High
Very High	X	Moderate	=	High
High	X	Moderate	=	High
Moderate	X	Very High	=	High
Moderate	X	High	=	High
Very High	X	Low	=	Moderate
High	X	Low	=	Moderate
Moderate	X	Moderate	=	Moderate
Low	X	Very High	=	Moderate
Low	X	High	=	Moderate
Moderate	X	Low	=	Low
Low	X	Moderate	=	Low
Low	X	Low	=	Low

Appendix 6: Key Questions and Answers in Relation to the Northern Caribou Strategy

1. **Many think that habitat management in the Itcha-Ilgachuz Caribou Range should emulate natural disturbance patterns in the area. How does the Northern Caribou Strategy address this issue?**

   The whole strategy is built on the objective of maintaining northern caribou in the face of modern-day realities. Many of those realities were defined by the CCLUP. We can't go completely back to the natural disturbance patterns any more than we can eliminate logging, snowmobiles, fire control, roads, and other development.

   We have made substantial use of natural disturbance ecology in the development of the strategy. For example, the strategy recommends **copying** the natural disturbance seral distribution on 4.2 per cent of the caribou range in the natural-disturbance-seral-distribution zone. We know of nowhere else in the province where the natural seral distribution is being copied. Another 24.6 per cent of the range is in parks; while 51.8 per cent is in conventional-harvest zones, where the biodiversity guidelines still fully apply and silvicultural systems that mimic natural disturbance are encouraged. On 13.0 per cent of the range, modified-harvesting is recommended with block (disturbance) size designed to mimic natural disturbance. Stand-level prescriptions that are different from natural patterns are necessary to successfully manage for caribou in the face of a shrinking range.

2. **Many pine stands in the modified-harvest area are already over-maturing. The forest industry is concerned about 'how trees will be managed into older ages (e.g. more than 500 years). How is this addressed?**

   This strategy is about caribou — minimizing risk to caribou to maintain populations in the long term. Stands do not suddenly disappear. In the MS pine stands, trees more than 500 years old have been found. If 50 years from now a new approach is warranted, we have the option to cut trees. We do not have the option to replace trees and therefore replace caribou habitat if we do the wrong thing now.

   The Strategy encourages the forest industry to harvest the oldest stands first and to cut in the SBPS first, as pine has a shorter pathologic rotation in this zone. Interestingly, only 39.9 per cent of the modified-harvest area is older than 140 years and only 2.1 per cent is older than 250 years. Applying the even-flow guidelines and targeting the oldest stands first will limit the age at which trees are cut. To date, there has been reluctance on the part of licensees to do modified harvesting on three-quarters of the caribou range. We encourage the industry to promptly get into these areas and to target the oldest stands first. If properly implemented, there should not be stands more than 500 years old in the modified-harvesting zone.

   When the modified-harvest area is fully managed on 80 per cent of the stands, the oldest trees (excluding wildlife tree patches) will only be 140 years prior to harvest while on the remaining 20 per cent, trees will be allowed to grow to 240 years.

3. **Given the forest health concerns surrounding dwarf mistletoe and its prevalence in the SBPS, how much of the modified harvest is located in the SBPS zone?**

The vast majority of the modified harvest has been shifted out of the SBPS for MPB and mistletoe concerns. Now only 4825 ha of mapped SBPS remain representing only 2.7 per cent of the modified-harvest zone.

4. **The strategy provides specific recommendations for dealing with the current mountain pine beetle infestation. Have these been developed in consultation with forest health professionals and licensees?**

Yes.

5. **This strategy has been developed over the past six years. Have formal consultation activities been conducted with stakeholders?**

Yes. During development of the strategy, consultations with stakeholder representatives (major forest licensees and regional conservation council) were extensive. Consultation was also initiated with First Nations and local stakeholders..

6. **Are the current modified-harvest and no-harvest lines carved in stone?**

Certainty in the location of these zones is in everyone's best interest. This allows planning to take place without the fear that the picture will suddenly change. However, changes in the boundaries of these zones of up to 200 m are possible to address on-site realties. The mechanism for doing this is described in section 5.3. Additionally, the whole strategy should be reviewed every five years to ensure that objectives are being met. However, we do not anticipate the need to shift the location of these zones even then.

7. **The forest industry is concerned that "blanket" harvesting prescriptions are being advocated. Is this true?**

This is a misconception. Whereas licensees are presently using only one silvicultural system for virtually all the SBPS and MS zones on the Chilcotin plateau, we advocate several systems to address caribou habitat requirements. Within the natural-disturbance-seral-distribution zone and conventional-harvesting zone covering 4.2 and 51.8 per cent of the range respectively; licensees are free to use whatever silvicultural system they deem appropriate. Two different silvicultural systems are recommended for the modified-harvest zone with variations in opening size and shape allowed to address aspect (see sections 5.5 and 5.6). In the face of MPB within the modified-harvesting zone, clearcutting with green-tree retention is another option licensees have in certain circumstances (see Section 5.8). Additionally, larger partial cutting openings are allowed in the SBPS to address MPB (see Section 5.8).

8. **The forest industry is especially concerned about the applicability of the recommended systems on spruce sites or on sites with a forest floor dominated by moss. Is this a problem?**

These sites are often good arboreal-lichen stands and are valuable caribou habitat. Additionally, caribou habitat is more than just the presence of lichens. These stands often provide valuable cover for caribou adjacent to open areas such as wetlands.

Additionally, the recommended silvicultural systems have been shown to decrease moss cover in openings by allowing more light and heat to reach the forest floor (Waterhouse and Armleder, unpublished data). Therefore if these

sites are able to produce more terrestrial lichen, the recommended treatments will probably enhance terrestrial lichen abundance.

9. **Will predator (wolf) control be required in association with Caribou management in this area?**

A wolf management program should be developed within northern caribou range. It is recommended that wolf reduction should be considered for caribou sub-populations where: there is imminent danger of extirpation or range reduction; and for which there is a Herd Recovery Action Plan or equivalent management strategy that requires predator reduction to meet recovery goals. The Rainbow herd is currently in decline and therefore is the priority area to implement wolf population reduction at this time.

10. **How is the issue of access management being addressed?**

Current knowledge suggests that the long-term persistence of northern caribou is dependent upon the perpetual supply of large, contiguous areas of suitable summer and winter habitat, with little or no vehicle access and human disturbance. In such areas, caribou can space out at low densities and reduce predation risk (Seip and Cichowski 1996).

The Northern Caribou Strategy partially addresses access management concerns by locating modified harvest in large, aggregated areas. If followed, this strategy will minimize access development across the entire caribou winter range, thereby reducing the overall impact of access development on the caribou population. Specific recommendations for motor vehicles, ATVs and snowmobiles use are outlined in the Access Management section of this report.