Strategic Ecological Restoration Assessment (SERA) of the Cariboo Forest Region

Results of a Workshop

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EXECUTIVE SUMMARY

Forest Renewal BC and Ministry of Environment Habitat Branch have initiated a new FRBC program – the Terrestrial Ecosystem Restoration Program (TERP). In order to provide a strong ecological foundation for this new program, a need for an assessment of Provincial strategic restoration priorities was determined. The purpose of a strategic assessment was threefold: a) to identify the most 'degraded' ecosystems in each region, b) to identify causal factors of degradation where possible and c) to summarise these data to guide investments in the TERP. To achieve this goal, a series of six regional workshops were organised for October and November, 2000. The results of the workshops are available in six reports, one for each Forest Region, and are referred to as the Strategic Ecological Restoration (SERA) reports. This report outlines the results of one workshop – held in the Cariboo Forest Region on October 24, 2000.

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The TERP Guiding Council – Nancy Turner, Don Eastman, Paul Senez and Maurice Hanson – provided overview comments on the results of the workshops.

TABLE OF CONTENTS

INTRODUCTION

Forest Renewal British Columbia (FRBC) has a mandate to support the restoration of forest resources damaged by logging and logging-related activities. Since 1994, this mandate has been met primarily by activities of the Watershed Restoration Program. Recognising that the Watershed Restoration Program does not meet the full range of restoration priorities, FRBC started to explore development of a Terrestrial Ecosystem Restoration Program in 1995. Since this time, some seed funding has been allocated to projects throughout the Province. However, in order to efficiently guide future terrestrial restoration efforts, the need for strategic direction has been recognised. Pandion Ecological Research Ltd. (technical) and Salasan Associates (organisational) were contracted in October and November 2000 by Habitat Branch MoELP and Forest Renewal BC to organise a series of regional workshops to assess ecological restoration needs across the province. Ecologists, foresters, biologists and restoration experts familiar with each region were invited and asked to systematically assess ecosystems in their region for the extent and causes and indicators of ecological degradation and to highlight ecosystems, habitats or ecosystem components most in need of restoration from an ecological perspective.

Objective

To produce a science-based strategic assessment of terrestrial ecosystem restoration needs regionally. Potential restoration needs were assessed based on ecological units primarily by Biogeoclimatic Ecosystem Units (BEC) subzones, and then specified to variant or individual areas where appropriate. Broad habitat types such as grasslands, wetlands were also identified where specific impacts are seen.

Participants were specifically asked:

1. What are the main agents / issues creating a need for restoration in this Forest Region? (degrading agents)
2. What are the indicators used to determine an ecological problem? (i.e. what is the evidence of an ecological problem)
3. What are highest priority impacts in each ecological unit in the Region?

Scope

The workshops focused on determining the ecological need for restoration in all terrestrial ecosystems and their interface with riparian systems, including non-forest land, private land, crown forest, rangeland, grasslands, small wetlands and urban areas. The workshop did not set out to address whether it is politically or socially possible to restore systems, but rather to simply address whether there is an ecological need for restoration. An effort was made to identify all major factors causing ecological degradation in order to identify potential cumulative impacts between agents. This workshop included the following biogeoclimatic variants in the Cariboo Region: Alpine Tundra, Bunchgrass, Engelmann Spruce- Subalpine Fir, Interior Cedar-Hemlock, Interior Douglas Fir, Montane Spruce, Sub-boreal Pine-Spruce and Sub-Boreal Spruce. A map of biogeoclimatic zones is provided in Appendix 3.

Participants

The intent of the workshops was to gather ecological information pertinent to each region. We therefore invited technical experts familiar with local ecosystems, their historical extent and form and their current status. Participants with a broad background in ecology, forestry, range, wildlife, conservation and restoration, plus specialists familiar with local restoration projects, non-native species, endangered species etc were encouraged to attend. An attempt was made to include a diverse range of expertise, and invite technical experts from Ministries, industry and consultants where expertise was known to be available. A list of participants is presented in Appendix 2.

Approach

In 1993, the Forest Ecosystem Management Team (FEMAT) working in the Pacific Northwest USA recommended that ecosystem restoration should be grounded in ecological theory, but must also take a pragmatic approach that would start by:

> *"determining all ecosystem restoration needs, then sifting these for the most important processes of concern, "treatability", cost-effectiveness, funding expectations, management situations, and institutional and socio-political considerations to arrive at the best implementable program"*

These Regional TERP workshops were intended to fulfill the primary function of 'determining all ecosystem restoration needs' at the strategic level.

Participants were specifically asked to avoid addressing questions other than those relevant to ecological impacts (i.e. avoiding political debate, or consideration of whether a problem was 'fixable' or not).

Limitations of the Process

The information presented in this series of reports is limited to that presented by participants at the workshops. We do not believe this constitutes a failing of the reports because the invited participants include many of the most knowledgeable professional ecologists, foresters and other ecosystem practitioners in the Province.

Participants were asked to detail ecosystem degradation in their region. Due to the nature of the workshop and the time available, it was often not possible to provide quantification, but only qualitative comments on the level of ecosystem degradation. Participants were asked to prioritise ecosystems and types of degradation for their region using a crude ranking system. We note that across the different regions, there tended to be repeatability of the types of systems and agents causing highest degradation. However, also note that the approach does not allow comparisons between different regions, only within individual regions.

Ecological Significance of Ecosystem Changes

Determining whether an ecosystem is degraded (or 'broken') is one of the key features of a restoration program. There is controversy over the details of how to assess ecosystem degradation, however, there is generally little disagreement that directional changes in pattern, distribution and abundance of ecosystem components away from natural patterns increases the risk to biodiversity values (Province of BC 1995). A system can be considered to be degraded (i.e. that the change is ecologically significant) when ecosystem component (s) are lost from the system, or changed in abundance or distribution sufficiently to impact the interconnecting components and species dependent upon them (Perry 1994). The ecological importance of many of the ecosystem components referred to in this report has been well documented and will not be reviewed in depth here, however as examples:

- Absolute area of habitat, relevant particularly to older/ mature forest in BC is documented to impact population demography and ability to support many species (Maser 1990; Noss 1996).
- Old-growth forests are known to support unique communities of flora and fauna (Goward 1993; MacKinnon 1998; Schowalter 1995; Winchester 1997), and are therefore important for maintaining biodiversity.
- Fire suppression is known to change the course of succession in NDT 4 ecosystems, and radically alter habitat availability for a large number of red and blue-listed species (Tiedmann et al. 2000).
- Large-sized and sufficiently abundant wildlife trees and coarse woody debris are known to be required to support many species requiring cavity-nests and woody debris for forage and nesting (Machmer and Steeger 1995; Franklin et al. 2000).
- Road density, and particularly those with high levels of use are known to significantly impact habitat quality and use by many species, and increase mortality patterns in other species (Forman and Alexander 1998; deMaynadier and Hunter 2000; Trombulak and Frissell 2000).

More controversial are questions, for example, regarding how fragmentation of mature/ old forest landscapes impacts the ability of the ecosystem to function (Harrison and Voller 1998). There are data that demonstrate certain species are impacted by forest fragmentation in a forested landscape (C. Kyle pers. comm.; Debinski and Holt 2000; Smith et al. 2000), however others maintain that fragmentation is not a concern for biodiversity in a mostly forested landscape (Bunnell 1999).

In this exercise, a decision was made to not debate these complex questions directly, but rather to use a combination of expert opinion and evidence on the extent of changes from natural patterns to provide strategic guidance as to which ecosystems are most degraded. In general, it is agreed that a combination of the following can be used to help determine which ecosystems have highest ecological degradation:

- ***severity and extent of change from natural patterns:*** increased change = increased degradation of the ecosystem

- ***scale of impact:*** are ecological processes, habitats or species impacted? As a general rule, processes have higher ecological significance because of cascading effects down onto habitat and species, but not necessarily in reverse
- ***ecological function*****:** does the ecosystem component impacted have a key ecological function? e.g. keystone species may have higher ecological impacts than other species
- ***geographic extent*****:** a large scale impact is likely more significant than small geographic extent
- ***ecological resilience*****:** systems with low ecological resilience will be impacted more heavily by equal disturbances than highly resilient systems
- ***extent of representation in protected areas*****:** high levels of protection may decrease the significance of high levels of impacts elsewhere
- ***component rarity*****:** rare ecosystems or components may be heavily impacted by relatively small changes
- ***cumulative impacts*****:** many small impacts may result in significant overall degradation.

Experts were asked to focus only on issues they considered to be ecologically significant in each area of their region. Two levels of priority setting were used in each variant grouping: a) which ecosystems are the most significantly degraded within each variant group and b) which ecosystems are the most significantly degraded overall for the region. This second priority setting allowed variants whose low priority issues are more ecologically significant than other variants' high priority issues to be identified.

The results of each workshop are summarised in six reports which are formatted in three sections, with increasing levels of detail:

Section I: **Summary of Regional Priorities:** tabulates the ecological zones noted as having the highest levels of ecological degradation in that region. For each ecological zone, the most important agents of degradation are specified.

Section II: **Summary Tables for All Ecosystems:** tabulates information for each ecosystem discussed during the workshop, including background information (biogeoclimatic variants, numbers of listed species, percent of area in protected areas), and the highest priority areas of concern within that ecosystem.

Section III: **Detailed Information for All Ecosystems:** tabulates all information collated for all ecosystems discussed during the workshop, organised by types of ecological impacts.

Note that the intention of these limited workshops was, as a first step, to assess the ecological need for restoration, and participants were asked to focus their comments on what they considered to be *ecologically significant* degradation issues. They were also asked not to prioritise their comments based on the feasibility of restoration, but rather to focus solely on ecological need. It is therefore likely that in some instances, apparently lower priority degraded ecosystems (e.g. those highlighted in section III) may provide the best investment for FRBC in this program.

SECTION I: SUMMARY OF REGIONAL PRIORITIES

Workshop participants were asked to prioritise which zones most urgently required restoration in their region, and this is summarised in the table below. Note that in general, participants were willing to identify only "high" and "low" priorities (due to the coarseness and limited time available for ranking). In which case all "high" priorities are presented in Table 1, and all other "low" priorities are presented in Sections II and III., Within the highest priorities a basic 'star' ranking system was used to determine variation between restoration needs. For each ecosystem identified, a brief rationale for the ecological significance of the high ranking is provided. Further background rationale is provided in the individual reports from each Region.

Table 1. Ecological zones with highest need for restoration, indicated by the number of "stars" given. "Stars" are given to indicate priorities – either for a whole zone, or for individual factors within zones where differentiation was made[1].

Rank	Ecological zones
***	Bunchgrass zone ➢ Cattle ranching and associated impacts: i) Trampling of riparian and rare communities, ii) Almost complete loss of climax grassland communities
***	➢ Access (ranching/roads) result in: increased distribution and abundance of non-native (agronomic and other) plant species;
**	➢ Fire suppression: encroachment of forest onto previously grassland habitat (most relevant on north aspects) and change in plant communities Rationale for rating: ➢ Very small percent of the region (0.1%) but high biodiversity values: high absolute number of listed species, and high density per unit area ➢ 21% of zone in protected areas, but these areas are negatively impacted by fire suppression and grazing pressure and so fail to protect ecosystem processes, or provide reference ecosystems ➢ Cattle grazing and fire suppression in combination are extensive in their impacts, and have cumulative impacts affecting all areas of the zone ➢ Encroachment is slightly lower priority, largely because it impacts only the 'interface' with forested zones ➢ Have lost/ or almost lost all reference ecosystems in these ecosystems ➢ Ecosystems not resilient to changes in ecosystem processes (e.g. suppression of fire results in forest ingrowth and so causes change in grassland ecosystems) ➢ Ecosystems potentially not resilient because they are at the northern end of their ranges, and susceptible to natural/ human-induced changes in climate ➢ Human population density increasing; and will continue to expand rapidly in this zone

[1] Note that each region determined its own ranking procedure – in particular, they determined the maximum number of 'stars' to be attributed to each item. These ranks are therefore relative ranks comparable within regions only, and cannot be used to distinguish between regions.

Rank	Ecological zones
	Comments ➢ Ecologically feasible to restore/ reduce impacts of ranching, however, requires extensive social involvement to provide willingness for change. ➢ Need to overcome social concern regarding reintroductions of fire
*** *** ***	Interior Douglas Fir ➢ Fire suppression resulting in forest ingrowth of historically open forest stands resulting in low economic value and low biodiversity value stands. Associated loss of large fire-maintained trees plus change in understory compositions. ➢ Forest encroachment onto existing open forest areas, resulting in loss of open forest and loss of associated plant communities ➢ Cattle ranching + associated impacts (in dry IDF only): i) Trampling of riparian and rare communities, ii) Increased introduction and movement of non-native plant species; iii) Almost complete loss of climax grassland communities Rationale for ranking ➢ This BEC zone supports the highest absolute number of listed species and communities in Province (though note that not all species occur in this Region) ➢ IDF covers 20% of region, but only 5% represented in Protected Areas (with only 1% of some of largest variants) ➢ Protected areas still impacted by fire suppression and grazing – therefore fail to protected ecosystem processes, or provide reference ecosystems ➢ Fire suppression + forest management approaches have resulted in radical change from natural disturbances patterns on the landscape, particularly with loss of large/ old Douglas Fir through zone, which has high biodiversity value and was historically extensively distributed through the zone. ➢ Combination of major degrading agents (ranching + fire suppression etc.), lead to exacerbated cumulative impacts ➢ Almost all zone is 'managed forest' due to very low level of inoperable forest – therefore extensive cumulative impacts over a large area Comments ➢ Restoration is ecologically feasible with currently available techniques, ➢ However, success potentially limited by Douglas Fir Beetle, and Workers Compensation Board Regulations. ➢ Need to overcome social concern regarding reintroductions of fire ➢ Ecologically feasible to restore/ reduce impacts of ranching. But requires extensive social involvement to provide willingness for change.

Rank	Ecological zones
***	Interior Cedar Hemlock ➢ Forest harvesting resulting in loss of historically abundant old growth attributes at both stand and landscape levels: i) Loss of old growth – dramatic reversal in seral stage distribution (predominantly old to predominantly young) ii) Remaining low elevation old growth highly fragmented by young seral forest and roads iii) Harvesting + short rotation forestry results in systematic loss of large-sized structures (live and dead) throughout zone. This will increase through time as percent managed forest increases iv) Silviculture approach: species conversion from western red cedar / western hemlock to younger seral species Rationale for ranking ➢ BEC zone covers 4% of Region ➢ Significant change from natural (recent historic) abundance and distribution of mature and old forest, particularly on valley bottoms and lower sloped plateaus ➢ Loss of 'connectivity' across valleys and plateaus may significantly decrease remaining habitat value for some species dependent on undisturbed or connected old growth (e.g. caribou; lichen population dispersal). ➢ Difficult to recreate large-sized / ancient attributes due to long time frame required. Important for numerous species, including red-listed mountain caribou/ ancient forest associated lichen species etc. Current stand level policy considered insufficient to maintain veteran trees throughout the managed forest into the future, ➢ Current policy considers all forest >250 years to be equally old and therefore fails to identify and manage for rare 'ancient' forests (>600 years or more) historically present in this system ➢ Concern at the table regarding 'unknown effects' on biodiversity of such significant stand and landscape level changes – consideration that current policy may foreclose options for the future Comments ➢ Prevention of further fragmentation and/ or loss of stand attributes is most pragmatic approach, due to very long timeframes involved. ➢ Plateau area is currently more degraded than mountainous ICH, therefore maybe focus efforts on remaining areas? ➢ Potential difficulties regarding conflicts with current policy
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Rank	Ecological zones
***	Sub Boreal Pine Spruce ➢ Forestry activity results in a) Very few large-sized patches of old/ mature forest remaining on entire landscape b) Harvesting does not retain fire refugia and older stand structures (the variation in natural disturbances is not mimicked) c) Changes in successional stage frequencies: loss of early shrub habitat and old forest due to truncation of succession at early and late seral stages, d) Extensive roading – highly operable Rationale for ranking ➢ Covers 25% of the region, with relatively low density of listed species per unit area ➢ However, only 3% represented in protected areas ➢ Although the change from natural disturbance patterns is overall less severe than in some other ecosystems (due to naturally large scale disturbances), considered to be still significant differences between forest management and natural disturbance patterns. Biodiversity values may be highly impacted because the changes are at the early and late successional stages which tend to have highest ecological diversity. ➢ Extensive impacts on ecosystem because it is highly accessible, and operable, therefore almost entirely managed forest. ➢ Due to difficulties of changing existing landscape patterns once they are on the landscape, it will be difficult to manage to large patches of mature forest in future, unless this is incorporated into planning at the present time. Current policy does not plan for adequately large areas of mature forest. Comments ➢ Ecologically feasible in near future. However will be difficult in future to change the patterns created at the landscape level. ➢ Potential difficulties regarding conflicts with current policy
***	Generic Comments (all zones) ➢ Access: throughout all zones, increasing road density was considered a major agent of degradation. Highlighted in areas where road-sensitive or hunted species were present. However, the general impacts of roads on habitat quality and use by many species was a concern throughout. Access management in the dry / flat zones is a particular issues since roads are not necessary to allow mechanised access.
**	➢ Future ecosystems of concern: Two BEC zones, montane spruce and engelmann spruce/ subalpine fir – particularly the wet variants (each approximately 12% of region) were noted as having currently low levels of degradation. However, it was also noted that harvesting history in these systems is recent, and that current management policies will not provide for adequate ecological protection in these systems as harvesting increases, leading to degradation as observed in other areas. Lower concern is related to the lack of immediacy in these systems

SECTION II: SUMMARY TABLES FOR ALL ECOSYSTEMS

The following tables present background information and priorities for all ecosystems discussed. Data includes i) area of each BEC variant[1], ii) numbers of listed (red and blue) animals and plants[2], iii) numbers of listed plant communities[2] and iv) % in protected areas[1]. For a list of acronyms see Appendix 1.

[1] Data from LUCO-protected areas database current to Feb. 2000.
[2] CDC data current to Dec. 1999. Note: numbers of listed species are approximate due to the nature of CDC database listings.

Alpine Tundra (AT)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
AT	Atp	729,283	30	0	21	42
Ecosystem Summary:	➢ Adequate representation in protected areas. ➢ Relatively little disturbance in general. ➢ Potentially vulnerable though due to general 'fragility' of the ecosystem and plant communities					
Ecological Priorities:	➢ Increased recreation use currently, and in the future: direct trampling impacts on plant communities and disturbance impacts. Disturbance has impacts for wildlife populations. ➢ Extensive grazing in some areas (particularly in the east) is causing damage due to direct trampling and changes in plant communities.					

Bunchgrass Zone (BG)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
BG	TOTAL	83,887	33		6	9	21
	xh2	467					5
	xh3	26,592					28
	xw2	56,828					18
Ecosystem Summary:	➢ It is expected that the BG historically experienced frequent fire return intervals: BGxh3 is probably about 40-50 years and BGxw2 is probably about 10-15 years based on data from the US ➢ Although the percent protected areas is quite high, these areas are negatively impacted by fire suppression and grazing in particular. They may therefore fail to protect natural ecosystems, and may also fail to provide benchmark ecosystems.						
Ecological Priorities:	➢ Extensive impacts from cattle grazing: Negative impacts associated with livestock include changing plant communities (invasion of agronomic species, direct trampling of native communities), trampling of riparian and wetland areas and transmission of non-native species. ➢ Fire suppression is leading to forest encroachment: approximately 29% of previously open grassland (< 5% cover of trees) in 1960's is now treed. The rate of encroachment is greatest in the IDFxm (upper grasslands). It is estimated that the 30 year rate of reduction in open grasslands is 21% in the IDFxm compared to 4% and 2% in the BGxw2 and BGxh3 respectively. If the rate of forest encroachment is unchanged over the next 85 years (120 years from mid 60's), the total reduction in area of upper grasslands will be about 74%. ➢ Access impacts: Roads are not necessary for vehicle travel throughout this zone. Extensive off-road travel is causing soil compaction, direct disturbance to species and is facilitating the spread of invasive species.						

Engelmann Spruce-Subalpine Fir (ESSF)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
ESSF	TOTAL	1,040,595	55		0	14	26
w	dc2	19,477					0
w	mv1	2,370					0
w	wc3	221,723					21
w	wk1	357,471					13
d	xc	11,131					60
d	xcp	207					0
d	xv1	270,552					35
d	xv2	94,747					28
Ecosystem Summary:	➢ Split into Coast / Chilcotin ranges (DRY) and Caribou Highlands (WET). The Dry variants include: ESSFxc, xcp, xv1, v2. The Wet variants include: ESSFdc2, mv1, wc3. ➢ DRY – is similar to the MS zone; not "classic" ESSF, but more like MS below AT. These variants are Pl dominated. There is very little history of logging or insect/disease. The disturbance pattern is NDT2 with stand replacing disturbances followed by slow succession. There is a lot of Pa at higher elevations. ➢ WET – is similar to ICH. There is minimal Pl, especially at mid – upper elevations. These variants are NDT1. Most of the landscape is OLD stands; there are very few young and mid seral stands. Closed forests are found at low elevations. There is a quick gradation into alpine communities and very limited Pa (on dry, exposed ridges).						

Ecological Priorities:	WET: ➢ Extensive change to natural disturbance pattern: These variants were historically dominated by gap dynamics, but are currently dominated by stand replacement disturbances (harvesting). There is inappropriate management for retention of old forest, and insufficient planning to maintain large-sized old patches into the future. ➢ Species conversion throughout zone is resulting in loss of large sized spruce, and loss of Pl and Bl. Short rotation forestry is also resulting in loss of arboreal lichens which may have direct impacts on caribou populations. DRY: ➢ Current development in the dry ESSF is fairly minimal, and has been initiated recently. However, there was concern that current planning guidelines and policy will not prevent the extensive problems found elsewhere from occurring here in the future – i.e. extensive loss of old forest, lack of planning for appropriate retained patch sizes, loss of specific large-sized stand structures etc.

Interior Cedar-Hemlock (ICH)

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
ICH	TOTAL	343,837	31		5	9	14
	dk	41,843					2
	mk3	103,891					4
	mw3	8,362					62
	wk1	27					93
	wk2	136,167					12
	wk4	53,548					40
Ecosystem Summary:	➢ Wetter variants are found in the valley bottoms of the Quesnel Highlands and Cariboo Mountains, while colder, drier variants are found on the plateau. ➢ ICH forests have the highest tree species diversity in the region. It is close to the northern range for Cw and Hw. Cw and Sx are found as climax species in the western portion of the ICH in the mk, dk, and mw3. Fungi and decay are important issues. Natural disturbance ranges include NDT1-2-3. ➢ There is an extensive harvesting history in the ICH with clearcut harvesting and prescribed burning the dominant silvicultural practices.						

Ecological Priorities:	➢ There has been extensive change away from natural disturbance patterns causing loss of old growth forest, particularly in valley bottoms. ➢ The naturally 'connected' landscape is becoming highly fragmented with sharp increases in the amount of early seral habitat present (especially at low elevations). ➢ There is a loss of large sized stand structures and other old growth associated stand structures. Under current harvesting, there will be no veteran trees in future managed stands as well as a loss of lichen species in future forests. ➢ There is a species conversion problem where stands are being converted from Cw/ Hw to Fd/ Pl (from a combination of changing seral stages and silviculture preferences) ➢ There are concerns regarding maintaining caribou populations into the future due to the combination of impacts listed above.

Interior Douglas Fir (IDF)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
IDF	TOTAL	1,646,743	40		26	4	5
	dk1	70					0
	dk3	874,038					1
	dk4	393,778					2
	dw	76,245					36
	mw2	12,342					21
	unv	6,542					50
	ww	9,169					100
	xm	240,793					7
	xw	33,765					16
Ecosystem Summary:	➢ High number of listed species ➢ Very low area of zone in protected area ➢ These issues increase the importance of factors listed below						

Ecological Priorities:	➢ Although there is some concern that rate of harvest is overall too high (and fails to manage for variation in natural disturbances), the type of harvest is considered potentially more important than the rate. Current management practices result in extensive loss of large sized dead and dying structures – effectively sanitizing the landscape and resulting in considerable change from natural stand structures. ➢ Fire suppression resulting in ingrowth of stands: it is estimated that more than 80% of the Fd stands adjacent to the grasslands are significantly ingrown (i.e. stem densities are much higher today than at the turn of the century, resulting in an inability of the stands to support biodiversity conservation, wildlife habitat, forage production, and timber production goals ➢ Lack of planning for non-industrially managed stands and lack of protected areas – all managed stands are for timber. There is no management for conservation and historic stand characteristics. There is very little area (or none) that hasn't had industrial intrusion (other than fire suppression). Thus, no benchmarks for what constitutes "natural" are available. ➢ Extensive impacts of over-grazing by cattle are resulting in direct changes in understory communities and direct changes due to introduction of non-native species (for forage and accidentally on roads etc)

Montane Spruce (MS)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
MS	TOTAL	1,015,666	27		3	7	9
	dc2	43,859					30
	dv	32,071					24
	xk	59,986					20
	xv	879,751					7
Ecosystem Summary:	➢ Generally, similar to SBPS in terms of impacts and ecology. Less frequent natural disturbances, thus there are more significant areas of old Pl stands. As with SBPS, dry Chilcotin areas have the highest levels of current impacts. ➢ The estimated fire return interval is 150-250 with high variability around disturbance intervals. ➢ Very dry variants include: MSxk and MSxv. ➢ Dry variants include: MSdc2 and MSdv.						

Ecological Priorities:	VERY DRY ➢ Clearcutting with short rotations is resulting in significant changes in the amount of a) old and rare old forest, and b) large patches of old / mature forest. This is a particular concern in the Chilcotin ranges. (similar to SBPS – except for very minor impact of MPB) ➢ Loss of large-sized stand structures (trees, snags, CWD). ➢ Access: extensive new roading is increasing wildlife poaching and the spread of invasive species. DRY ➢ Impacts are currently less significant – there is concern that future planning will fail to avoid problems facing other areas.

Sub-boreal Pine-Spruce (SBPS)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
SBPS	TOTAL	2,139,692	28		4	9	3
	dc	409,016					6
	mc	121,258					7
	mk	551,061					0
	xc	1,058,357					3
Ecosystem Comments:	Low productivity for timber. Logging started 15-20 yrs ago. Substantially impacted due to Mountain Pine beetle (MPB). NDT3 with 1-1000ha fires (some of the largest fires in the province – 5-6000ha).						

Ecological Priorities:	➢ Rate of harvest and landscape fragmentation: although differences compared with natural disturbance patterns are not as severe as in other BEC units, there are important differences in the size of patches, range of intensity of disturbances across the landscape, and specific loss of rare old forest. ➢ MPB Salvage: policy is too general and facilitates extensive green tree removal. Planning and policy are not specific enough to highlight rare microsites with rare old forest. ➢ The variation in natural disturbances is not mimicked. Harvesting is not leaving fire refugia and older stand structures. ➢ Changes in successional stage frequencies: loss of early shrub habitat and old forest due to truncation of succession at early and late seral stages. This impacts biodiversity since these phases tend to have highest diversity. ➢ Fire exclusion: extensive ingrowth is creating economically unviable stands, which simultaneously have very low biodiversity values. This is an increasing problem with no obvious solution. It is also resulting in changes in plant communities in these stands. ➢ Extensive roading to maintain even timberflow: negative impacts on wildlife (direct and indirect).

Sub-boreal Spruce (SBS)

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue		Listed communities	Protected areas (%) Province	Region
SBS	TOTAL	1,139,681	25		5	6	3
	dw1	332,603					1
	dw2	252,736					0
	mc1	41,772					0
	mc2	129,454					7
	mc3	5,476					0
	mh	76,869					0
	mm	8,070					0
	mw	140,324					0
	wk1	152,376					15

Ecosystem Summary:	➢ More variation in this system than highlighted in the Biodiversity Guide Book. ➢ The workshop discussion split the SBS into a "Transition" zone between the interior "dry belt" and "wet belt" and a "Wetter" zone found at higher elevations on the drier part of the plateau and closer to the mountains. The Transition zone includes the SBSdw1, dw2 and mh and is reasonably dry. The Wetter zone includes the SBS wk1, mc, mw and mm. Higher snowfalls are found in the Wetter variants. ➢ There are many wetlands in this zone. ➢ In the mc1, and mc2, Pl is relatively common and wetlands are less common. ➢ Transition zone between 'wet and dry' has higher levels of grazing and agriculture, and also has higher levels of partial cutting. Wetter areas have little grazing/ agriculture impacts.
Ecological Priorities:	<u>Transition</u>: ➢ Very high rate of cut: creating significant changes from natural distribution of seral stages, particularly loss of old forest, and considerable change in patch sizes. There is a concern that there are few remaining large mature/ old patches in this landscape. Impacts are most significant in SBSdw1/ SBSdw2 where there is very little remaining old forest, and no large patches of mature forest remaining. ➢ Extensive forest health issues coupled with management focussing on timber are causing the loss of large-sized stand structures throughout the zone. <u>Wetter</u>: ➢ Loss of old forest and high rate of cut are impacting the landscape pattern. The impact is significant in more localized areas within the wetter SBS with an increased impact in western areas of the Region. Highest priority area: SBSmw and SBSwk1 where the rate of harvest and loss of old forest and riparian management are most severe.

SECTION III: DETAILED INFORMATION FOR ALL ECOSYSTEMS

The following tables contain all the information presented at the workshop-generally using terminology presented at the workshop. See Appendix 1 for list of acronyms.

Alpine Tundra

ISSUE	Ecosystem components impacted:
Landscape level:	➢ Adequate area in protected area. ➢ Few other landscape level impacts.
Range	➢ Extensive negative impacts from cattle grazing, especially in eastern AT.
Access	DRY AT ➢ High impact of increased access (through lower elevations) on wildlife populations (particularly related to snowmobiling and ATVs).
Specific species habitat	➢ High concern for disturbance impacts of increased access on wildlife (caribou and goats particularly) throughout zone.

Bunchgrass Zone

ISSUE	Ecosystem components impacted:
Landscape level: - management of PAS - tenure - extent of change from natural disturbance patterns	➢ Adequate protected area, however, cattle grazing is allowed in PA – so negative impacts continue (see below for details). ➢ Fire suppression is leading to extensive forest encroachment problems (Fire return interval : BGxh3 is probably about 40-50 years and BGxw2 is probably about 10-15 years based on data from the US ➢ The area being impacted by encroachment needs to be determined. There is considerable change in natural plant communities as a result of the combination of fire suppression and cattle grazing. ➢ Tenure: There is a relatively high proportion of private land, which tends to exacerbate planning problems, and increases the amount of conversion to agronomically productive areas (grazing).

ISSUE	Ecosystem components impacted:
Range	➢ Extensive cattle and sheep grazing results in: a) significant degradation of riparian areas (from trampling and pollution); b) extensive conversion of grasslands to agronomically viable species; c) exacerbates problems associated with non-native species - particularly where mineral soil is disturbed, allowing increased distribution of non-native 'weedy' invasive species. (Some are introduced purposely; others are transferred by cattle). ➢ There are a large number of red and blue listed species (plant and animal) associated with grasslands and a high impact on biodiversity from the above changes.
Direct habitat loss	➢ Fairly extensive private land is increasing pressure to convert grasslands to agriculture/ pasture. ➢ Direct loss of 'old seral' grasslands
Access	➢ Access is an extensive problem. Roads are not needed to drive through this zone. There is extensive off-roading, with nothing to prevent this access (policy or otherwise). It exacerbates non-native species problems, and the direct loss of native species (plant and animal) due to high soil disturbance/ compaction and direct disturbance.
Rare ecosystem impacts	➢ There is a high diversity of systems with many rare species. However, there is inadequate protection for these species in planning/ management strategies.
Invasive species	➢ There are extensive impacts from non-native species, in particular Hounds tongue (although it is less of an issue here than in the IDF). ➢ There is a general problem of grassland species conversion to agronomic non-native species, resulting in significant and extensive changes to plant communities in this zone.
Specific species habitat	➢ There are a high number of listed species associated with the BG zone and inadequate protection provided by policy.

Interior Douglas Fir

ISSUE	Ecosystem components impacted:
Landscape level: - planning - representation of ecosystems in PAS - extent of change from natural disturbance patterns	➢ Fire exclusion resulting in a) considerable ingrowth and overly dense stands; b) forest encroachment on grasslands; c) loss of forage particularly for ungulates; d) exacerbates fir bark beetle; e) loss of habitat for large number of listed spp. Overall: have a highly stressed system which has been pushed to another category of disturbance types – i.e. fuel loading and high forest health problems result in high potential for catastrophic stand-replacing fires
Stand level impacts: - simplification of forest structure - silviculture	➢ Majority of the changes in natural disturbance patterns are exhibited at a stand level: extensive loss of large stand structure, without planning for replacement (i.e. not systematically managing for long rotation stand structure throughout the zone). Although deer winter range guidelines reduce this problem in some areas, it is still extensive throughout this zone. Historic and current logging results in loss of large trees throughout. ➢ Primary issue exacerbated by WCB guidelines –extensive impact especially in areas where selective silviculture systems are being used – results in total loss of dead and dying. ➢ Lack of coarse woody debris management: ability to utilize small sized wood pieces in many areas resulting in thorough removal of coarse woody debris impacting a) habitat for many species and b) concern over long-term productivity losses on these sites. ➢ Fire suppression results in significant changes in understory characteristics: shrub/ herb to moss dominated. Has local habitat impacts, and also potentially results in lower growth rates for timber.
Forest Health management	➢ Extensive fir bark beetle and spruce budworm are exacerbating the loss of remaining large-sized Fd due to increased stress. ➢ Inappropriate management resulting in loss of many green trees and an inflated AAC is causing concern about long-term impacts.
Invasive species	➢ Relatively low concern for noxious weeds, but important changes in species composition and frequency are occurring - though not necessarily due to noxious species. Spreading of non-native species on roads and due to grazing throughout the zone is a serious problem. ➢ dk3 – tragopogon ➢ dk4 – tragopogon ➢ xm – Hounds-tongue ➢ xw – knapweed

ISSUE	Ecosystem components impacted:
Access	➢ Extensive road network in this relatively accessible area. ➢ Particular concern regarding increased hunting and poaching throughout the entire zone (few areas are inaccessible). This is particularly important due to high value ungulate areas.
Habitat loss	➢ Relatively high percentage of this zone is settled for homesteads/ agriculture. ➢ Many linear developments in this zone. ➢ High impact of subdivisions and developments near roads and lakes; these may have a particular impact on wetlands/riparian.
Non-forest impacts - range	➢ Extensive cattle grazing/ trampling causing wetland, streamside riparian and grasslands damage.

Interior Cedar-Hemlock

ISSUE	Ecosystem components impacted:
Landscape level: - extent of harvest - planning - representation of ecosystems in PAS - extent of change from natural disturbance patterns	➢ Extensive change from natural disturbance regimes: high rate of stand initiating disturbances causing a change from gap dynamics to stand initiating disturbances - particularly in ICHwk. ➢ Current harvesting patterns exacerbated by high level of historic harvesting here – leading to a loss of connectivity at low elevations (and high old growth fragmentation). ➢ Loss of low elevation old growth particularly in valley bottoms (i.e. even though significant areas of old growth are remaining in this zone, the tendency to log valley bottoms has considerably changed the pattern on the landscape. ➢ In particular, in the ICHdk3/ dk4/ dw/ mw2: old forest is a scarce resource. ➢ There has been considerable change in patch size dynamics – few low elevation large-sized patches remain. ➢ Land Use Plan results in increased harvest in non-visual areas – which further exacerbates high harvest levels in remaining 'non-visual' areas (i.e. focusing turnover of forest into certain areas of the landscape).
Stand level impacts: - simplification of forest structure	➢ Extensive loss of large sized structures throughout the zone, especially in valley bottoms. ➢ Species conversion from late seral to early seral species is pervasive throughout the zone (change from Cw/ Hw to Pl/ Fd). ➢ Short rotation forestry is resulting in a lack of planning for future stand structure – i.e. problems will increase through time due to inadequate planning. ➢ Loss of large CWD – particularly loss of Cw in 120 year rotations.

ISSUE	Ecosystem components impacted:
Riparian impacts	➢ Extensive impact on valley bottom riparian systems – historic logging to stream banks and current rate of harvest are resulting in little remaining riparian old growth (which has potentially among the highest value for biodiversity).
Access	➢ High road density throughout the zone is causing concern due to wildlife disturbance impacts. ➢ The Western plateau has a particularly high road density (due to topography) which appears to facilitate predator movement and has negative impacts on caribou populations.
Rare ecosystem impacts	➢ Little known about rare ecosystems, but potentially highly diverse/ rare ecosystem components ??
Specific species habitat	➢ There is a high negative impact on early winter caribou habitat due to loss of old growth in many areas.

Engelmann Spruce-Subalpine Fir

ISSUE	Ecosystem components impacted:
Landscape level: differs between wet and dry regions - extent of harvest - planning - representation of ecosystems in PAS - road densities - extent of change from natural disturbance patterns	WET: ➢ Significant change from natural disturbance type – gap dynamic dominated system to stand replacing system. Current rate of harvest is too high, causing significant changes to landscape pattern (historically, very high percentage old growth) and systematic reduction in available old growth. Landscape pattern is changing extensively – loss of historic connectivity between old growth. Potential impacts on caribou populations. DRY ➢ Historically not extensive logging, so minimal current issues due to forestry (see notes above in summary).
Stand level impacts: - simplification of forest structure	➢ Species conversion: SxBlPl to Sx and Pl (not planting Bl; Pl not doing well). ➢ Inappropriate stand level management – causing loss of arboreal lichens.
Range	DRY ➢ fairly extensive cattle grazing impacts – direct trampling impacts, especially on wetland / riparian areas ➢ **Potential spread of invasive species (though currently not extensive?)????**
Riparian impacts	➢ Cattle grazing impacts, particularly in wet variants

ISSUE	Ecosystem components impacted:
Access	WET ➢ Significant increase in roading: improves predator access to caribou (wolf access); and increases disturbance for this disturbance-intolerant species ➢ Potential high impact of snowmobiles – though effects not quantified DRY ➢ Access increasing – expect future impacts since there is no management planning to prevent the problem from increasing in future.
Specific species habitat	➢ Loss of arboreal lichens that are central to maintaining caribou populations. Future impacts are unknown as the entire landscape is accessed.

Montane Spruce

ISSUE	Ecosystem components impacted:
Landscape level: - planning	➢ Relatively recent harvesting history – so landscape pattern issues currently small ➢ Concern that current policy is inadequate to prevent this landscape from becoming fragmented with little old-growth and little stand structure. ➢ Generally, thought to be heading towards the patterns and problems in the SBPS (except for less impact of forest health – due to colder climate). See SBPS comments above.
Stand level impacts: simplification of forest structure	➢ Loss of large sized structures in areas where harvesting has occurred ➢ Clearcutting with short rotations is causing negative impacts on lichen populations – future impacts on caribou populations, especially as development increases in future
Access	➢ Currently relatively minor roading, however, it is starting to increase and there is concern that this will be a future problem. Increase in poaching and increase in invasive species from roads.

Sub-Boreal Pine-Spruce

ISSUE	Ecosystem components impacted:
Landscape level: - planning - representation of ecosystems in PAS - road densities - extent of change from natural disturbance patterns - fire exclusion	➢ Current management fails to mimic natural disturbance by applying same rotation to entire landscape resulting in significant changes in remaining forest patch sizes on the landscape from natural conditions. Impacts unknown, but a) few large mature /old patches remaining and b) loss of rare 'old' lodgepole pine stands. Exacerbated by single approach to management across landscape, plus short rotation length ➢ Fire exclusion: ingrowth causing 'doghair' stands of little commercial value (with no incentives by forestry to deal with) ➢ Species composition in non-forested ecosystems changing due to suppression of fire
Stand level impacts: simplification of forest structure	➢ Wildlife tree patches fail to maintain appropriate long rotation large sized trees due to combination of policy and approach problems (e.g. concern over forest health impacts). ➢ Lichen species lost due to short rotations and clearcut with mechanical site preparation. ➢ Mechanical site prep removing shrub cover stage following harvest - implications for many species (unsure of the extent). ➢ Narrow range in density of young stands (insufficient variation in stocking standards).
Forest Health management	➢ Extensive MPB salvages leading to lower volume of dead wood on landscape. ➢ Reduction in rare old lodgepole pine. MPB salvage does not account for microsite differences and does not maintain or manage for future rare old Pl. ➢ Mistletoe: potential negative biodiversity impacts of sanitizing stands for mistletoe – loss of stand structure; reluctance to retain WTP ➢ In the mk – recent infestation at high levels by MPB. Salvage is an increasing problem.
Access	➢ High road density. Exotic weed species being spread intentionally with seeding, and non-intentionally by movement. ➢ Wildlife movement patterns changed – historical patterns along riparian changed to movement along or limited by road corridors.
Range	➢ Extensive cattle grazing causing decrease in above ground biomass and changes in species composition ➢ Focused impacts on riparian systems due to trampling (riparian edges/ shrub carrs/ streamside) ➢ In the xc there are particularly high impacts. Cows in dry non-forested areas are causing high grazing pressure.

ISSUE	Ecosystem components impacted:
Specific species habitat	➢ Terrestrial lichen is important for woodland caribou. Ground lichen is being lost from the landscape. This is a particularly important issue in the SBPSmc.

Sub-Boreal Spruce

ISSUE	Ecosystem components impacted:
Landscape level: - extent of harvest - planning - representation of ecosystems in PAS - extent of change from natural disturbance patterns	➢ Extensive change from natural disturbance patterns due to rate and type of cut – resulting in extensive loss of old and mature forest, plus considerable changes in patch sizes. Very few large sized mature/ old patches remain on the landscape. Highly fragmented landscape. ➢ Highest impacts are in wetter areas (particularly SBSwk1 and SBSmw – which currently have more old forest remaining, however concern that current expansion of harvesting here will have high impacts). ➢ SBSdw1/ SBSdw2: particularly high impact of historic fires and harvesting ➢ Fire exclusion/harvesting combination: stand conversion from deciduous to coniferous stands. Some discussion on the implications of settlement/ mining burning in the early part of the century, however, agreement that pure aspen stands are being converted to mixed stands with a minor At component. Concern due to high biodiversity value of this species. ➢ Windthrow issues, (particularly in wetter variants) resulting in inadequate riparian management and loss of riparian reserve zones. ➢ Cattle grazing and stand conversion throughout zone resulting in significant loss of Fd. ➢ Fire exclusion impacts (see IDF) are significant on edge of this zone, on steep W facing slopes. ➢ Highest priority area: SBSmw and SBSwk1: rate of cut/ loss of old forest and riparian management are worst in this variant.
Stand level impacts: - simplification of forest structure	➢ Partial cutting in this zone is resulting in stand conversion from Fd/ Pl stands to Pl stands – losing the Fd component. ➢ No management for CWD, or for maintaining stand structure (standing and down) into the future. Particularly important for large sized pieces.
Forest Health	➢ Extensive fir bark beetle and mountain pine beetle salvage; also Armillaria. ➢ Inappropriate management focus for ensuring retention of adequate stand structure through time – extensive loss of old forest attributes throughout the landscape.

ISSUE	Ecosystem components impacted:
Direct habitat loss	➢ SBSmh: Land conversion to agriculture and subdivisions – resulting in direct habitat loss. ➢ Wetter variants: extensive forest burning due to historic mining activities making it currently difficult to meet targets for old and mature forest. Exacerbated by current harvest and policy.
Riparian impacts - including wetlands	➢ High levels of cattle grazing and trampling impact vegetation here more so than other areas due to particular vegetation types in this zone (forbe dominated). Results in a shift in the structure of forbe communities in younger stands. ➢ Wetter variants: localized impacts on riparian areas due to mining for plaster, leaving open mine spoils. ➢ Wetter variants: concern about windthrow resulting in poor management to maintain riparian reserve zones – tendency to avoid leaving any structure (i.e. inappropriate use of riparian management zones). Impact is quite extensive in this zone.
Access	➢ Extensive access impacts: entire area is fully roaded (no unroaded valleys; all operable). High accessibility. ➢ Suspected to change patterns of habitat use by many animals. ➢ Increases hunting /poaching pressures throughout landscape – important that there are no areas without roads. ➢ Wetter variants: extensive roading is providing access to important higher elevation areas, particularly caribou areas for summer and winter traffic. Potential high impact here. Due to historic harvesting patterns, impact is higher in western areas.

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APPENDIX 1. LIST OF TERMS AND ACRONYMS USED IN THIS REPORT

Acronym	Meaning
AAC	Allowable Annual Cut
AC	Age Class
ALR	Agricultural Land Reserve
AT	Alpine Tundra BEC Zone
Act	Black Cottonwood
ATV	All-Terrain Vehicle
BEC	Biogeoclimatic Ecosystem Classification System (for more information regarding the BEC System, refer to: www.for.gov.bc.ca/research/becweb/becinfo/index.htm)
BEO	Biodiversity Emphasis Option
BG	Bunchgrass BEC Zone
BGB	Biodiversity Guidebook
Bl	Subalpine Fir
CDC	Conservation Data Centre (for more information regarding the CDC, refer to: www.elp.gov.bc.ca/rib/wis/cdc/index.htm)
CDF	Coastal Douglas Fir BEC Zone
Cw	Western Redcedar
CWD	Coarse Woody Debris
CWH	Coastal Western Hemlock BEC Zone
Ep	Paper Birch
ESSF	Engelmann Spruce Subalpine Fir BEC Zone
FC	Forest Cover
Fd	Douglas-fir
FEMAT	Forest Ecosystem Management Team
FPC	Forest Practices Code
FRBC	Forest Renewal British Columbia
FRI	Fire Return Interval
FTG	Free to Grow
ha	Hectare
Hw	Western Hemlock
ICH	Interior Cedar Hemlock BEC Zone
IDF	Interior Douglas Fir BEC Zone
LRMP	Land and Resource Management Plan
LU	Landscape Unit
LUCO	Land Use Coordination Office

Acronym	Meaning
LUPG	Landscape Unit Planning Guide
Lw	Western Larch
MH	Mountain Hemlock BEC Zone
MoELP	Ministry of Environment, Lands and Parks
MOF	Ministry of Forests
MPB	Mountain Pine Beetle
MS	Montane Spruce BEC Zone
NC	Non-Contributing
NDT1	Natural Disturbance Type 1: dominated by rare stand-initiating disturbances
NDT 2	Natural Disturbance Type 2: dominated by infrequent stand-initiating disturbances
NDT 3	Natural Disturbance Type 3: dominated by frequent stand-initiating disturbances
NDT 4	Natural Disturbance Type 4: Fire-maintained ecosystem
NFR	Nelson Forest Region
OG	Old Growth
Pa	Whitebark Pine
PAS	Protected Areas Strategy
Pl	Lodgepole Pine
PP	Ponderosa Pine BEC Zone
PSP	Permanent Sample Plot
Pw	Western White Pine
Py	Ponderosa Pine
SBPS	Sub-boreal Pine Spruce BEC Zone
SBS	Sub-boreal Spruce BEC Zone
sph	Stems Per Hectare
spp	species
Sx	Hybrid White Spruce
TEM	Terrestrial Ecosystem Mapping
TERP	Terrestrial Ecosystem Restoration Program
THLB	Timber Harvesting Land Base
TSR	Timber Supply Review
VQO	Visual Quality Objective
WCB	Workers' Compensation Board
WHA	Wildlife Habitat Area
WTP	Wildlife Tree Patch

APPENDIX 2. PARTICIPANT LIST

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APPENDIX 3. MAP OF REGION SHOWING BIOGEOCLIMATIC ZONES