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

Results of a Workshop

February 2001

Prepared by:

Rachel F. Holt
Pandion Ecological Research Ltd.

Prepared for:

Forest Renewal BC
Ministry of Environment Habitat Branch

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 Assessment (SERA) reports. This report outlines the results of one workshop – held in the Nelson Forest Region on November 15, 2000.

ACKNOWLEDGEMENTS

We would like to thank the following people for participating in the workshops: Pat Field, Tom Braumandl, Rob Walker, Kari Stuart-Smith, Marlene Machmer, Brendan Wilson, Dave White, Gerry Fox, Greg Utzig, Maurice Hanson, Kindy Gosel, Rob Gay, Don Gayton, Val Miller, Guy Woods and Mike Panian

Deb MacKillop provided an excellent and invaluable and key service in note-taking, sifting and sorting comments throughout the workshops, plus aided with data machination and information sorting. Salasan Associates, in particular Cindy Bertram; Cathy Scott-May and Colin Rankin organised the administrative aspect of all workshops.

Mike Fenger provided a note-taking service when required, and Mike Fenger and Janet Gagne provided overview direction and input throughout this process.

Conservation Data Centre (MoELP) provided data sets for listed species and listed community types. Land Use Coordination Office provided data on percent of each subzone in protected areas. Watershed Atlas data was provided by MoELP and advice provided by Malcolm Gray and Victoria Stevens.

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 Nelson Region: Alpine Tundra, Engelmann Spruce-Subalpine Fir, Interior Cedar-Hemlock, Interior Douglas Fir, Montane Spruce and Ponderosa Pine zones. A map of the major biogeoclimatic zones considered is shown 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 and Priorities
	Interior Douglas Fir and Ponderosa Pine (***) Montane Spruce (**)
***	➢ Fire exclusion combined with harvesting practices leading to: i) Extensive ingrowth of historically open forest stands, resulting in low biodiversity and economic value ii) Loss of open forest stand attributes (large snags and live trees), iii) Changes in plant communities iv) Increase in forest health issues
***	➢ Combination of cattle ranching, fire exclusion, settlement and increases in road density and recreation result in i) Rapid increase in the abundance and geographic extent of non-native species (noxious and non-noxious): ii) Heavy pressure on any remaining native grassland plant communities
***	➢ Cumulative impacts of high urban and agricultural development increasing direct habitat loss
	Rationale for ranking ➢ 6% of Region (IDF), with highest absolute number of listed species in Province ➢ 1% of Region (PP) with very high number of listed species per unit area ➢ 7% of Region (MS) with high number of listed species per unit area ➢ Highly under-represented in Protected Areas Strategy (PP: 0.2%; IDF: 1%; No IDF protected in Boundary District; MS 7%) ➢ Have lost/ or almost lost all reference ecosystems in these ecosystems ➢ Ecosystems not resilient to changes in ecosystem processes (e.g. removal of fire and forest ingrowth results in change to different ecosystem)

[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 and Priorities
	➢ Ecosystems potentially not resilient because they are at the northern end of their ranges, and susceptible to natural/ human-induced changes in climate ➢ Almost all of the zone is 'managed forest' or private land due to high operability and low protected areas <u>Comments</u> ➢ The East Kootenay Trench Restoration Plan provides a model for other restoration strategies. Extensive networking has allowed ranching and urban community to understand and participate in reintroduction of fire. In many areas of the Province, it was thought that this level of agreement would be difficult to attain. ➢ May be difficult to initiate a similar process in the western/ Boundary district ➢ However, there is a large concern that restoration of the dry ecosystems will fail unless there is high regard for the potential negative impacts of invasive species. They must be adequately managed, otherwise the supposed ecosystem benefits will not be achieved. Once established, many of these species (e.g. Leafy Spurge and Knapweed) will disperse into undisturbed habitats, irrespective of the levels of disturbance. ➢ Natural (recent historic) fire disturbance rates in dry ICH are difficult to determine due to extensive settlement burning at the turn of the century ➢ Appropriate stand level management hindered by Workman's Compensation Board and firewood cutting
**** *** ***	<u>Dry Interior Cedar Hemlock (ICHxw/ ICHdw)</u> ➢ Dam building (to create reservoirs) on major river systems, plus high historic urbanisation result in extensive loss of these ecosystems. Particularly, loss of high percent of riparian/ wetland systems and associated biodiversity ➢ Fire exclusion resulting in ingrowth, exacerbating forest health issues (less dramatic than in IDF and PP) ➢ Forestry activities result in: i) Loss of large sized/ fire maintained attributes (large Fd/ Py) through historic clearcut harvesting (inappropriate to the natural disturbance type) ii) Almost 100% loss of NDT1/ NDT2 old growth in ICHdw (i.e. riparian Cw/ Hw old growth) iii) Loss of larger old growth patches, plus changes in patterns and distribution of retained old growth <u>Rationale for ranking</u> ➢ ICH is a large zone (25% of Region), but the dry variants constitute a relatively low percentage of the total (ICHdw 16% of ICH; ICHxw 2% of ICH) ➢ High under-representation in protected areas: ICHdw (6%); ICHxw (0%) ➢ Relatively large number of listed species; with high number of listed species per unit area ➢ Highly diverse forest ecosystems – high inherent ecological values ➢ Cumulative impacts of habitat loss and degradation extensive throughout the zone

Rank	Ecological Zones and Priorities
	➢ Current policy not considered adequate to maintain adequate old growth, particularly since it does not allow representation below variant level. ➢ Current policy not considered adequate to maintain stand level veteran attributes into the future of managed forests Comments ➢ Natural (recent historic) fire disturbance rates in dry ICH are difficult to determine due to extensive settlement burning at the turn of the century ➢ Appropriate stand level management hindered by Workman's Compensation Board and firewood cutting
	Interior Cedar Hemlock (all variants)
***	➢ Forestry operations have resulted in dramatic changes to natural ecosystem patterns at both stand and landscape levels, resulting in
***	➢ Loss of old forest attributes throughout zones (e.g. large sized structures - live, dead and coarse woody debris)
***	➢ Loss of old forest, with dramatic losses at low elevations. The extent of pattern change currently most excessive in drier subzone/ variants due to historic settlement patterns. In future, extent of change will be most dramatic in wet subzones due to historically high levels of old growth.
**	➢ Increased fragmentation of remaining mature/ old forest landscape by younger seral forest and roads. Dramatic changes in patch sizes of remaining old forest.
****	➢ Dam building (to create reservoirs) at low elevation in northern / wet variants resulted in loss of locally rare areas of highly diverse valley bottom habitat. Significantly changed habitat for many terrestrial and aquatic species, plus ecosystem processes (including associated marshes/ wetlands etc – now very rare ecosystems)
**	➢ Invasive species: the ICH (particularly on some drier sites, but throughout the zone) provides highly productive sites for a large number of invasive species. There are relatively few plant communities (particularly on some sites) that have not been impacted. Rationale for ranking ➢ High variation in numbers of listed species: highest numbers in south and at low elevation. ➢ Poor representation of whole ICH in protected areas, with extremely low representation in southern/ dry/ low elevation variants (e.g. 7% overall; 0% in ICHxw) ➢ BEC zone has highest tree species diversity in Province. High inherent ecological values. ➢ Extensive loss in large-sized stand level attributes (from forestry, firewood cutting, fire suppression, settlement) known to be important for maintaining a large number of species

Rank	Ecological Zones and Priorities
	➢ Specific old-growth dependent/ disturbance intolerant species (e.g. mountain caribou) remnant populations in south of this zone – exhibiting considerable population declines in recent past and on-going. ➢ 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 ➢ Current policy not considered adequate to maintain stand level veteran attributes into the future of managed forests (large Fd/ Py in drier variants/ large Cw/ Hw in wetter variants) ➢ Current policy not considered adequate to maintain adequate old growth, particularly because it does not allow representation below variant level, and because extent of change from natural abundance and patterns is dramatic (particularly in moist and wet variants) . <u>Comments</u> ➢ A rate of harvest considerably higher than natural forest turnover rates. Considered the most fundamental degrading factor. ➢ Appropriate stand level management hindered by Workman's Compensation Board and firewood cutting ➢ Some disagreement regarding the ecological importance of fragmentation in these landscapes ➢ Prevention of further fragmentation and/ or loss of stand attributes is most pragmatic approach, due to very long timeframes involved.
** **	<u>Engelmann Spruce Subalpine Fir and Alpine Tundra</u> ➢ Backcountry tenures + general recreation access (especially, but not exclusively motorised) increasing at a rapid rate. Potential disturbance to alpine mammals/ trampling of plant communities. Insufficient control over expansion of these areas. ➢ Whitebark pine being lost from ecosystem (in ESSF), due predominantly to white pine blister rust, and possibly exacerbated by fire exclusion <u>Rationale for Ranking</u> ➢ Critical habitat for sensitive species (mountain caribou and goats) ➢ Fairly high numbers of listed species (though low per area number) ➢ Low resiliency in these ecosystems – at the edge of ecological limits for growth. Systems will be slow to recover from degradation. ➢ Whitebark pine appears to be a keystone species, linking multiple species throughout the ecosystem ➢ Slightly lower ranking due to relatively high representation in protected areas> however, concern that populations of sensitive and/ or large-ranging species will not be maintained by protected areas (e.g. grizzly bear/ caribou).

Rank	Ecological Zones and Priorities
	➢ No consideration of the cumulative impacts of recreation and forestry operations (i.e. no agency overseeing this). Comments ➢ Lack of inventory prevents adequate assessment of impacts
	Generic Comments (all zones)
***	➢ Concern regarding current approach to forest management which requires high density and continually accessed roads. Many species sensitive to disturbance and/ or increased mortality resulting from roads. Plus likely reduced value of retained habitat in highly roaded landscapes. In the Nelson Forest Region, there are 59,000 km of roads (calculated using 1990 data). There are 8000ha of mainline roads in the Arrow District alone, many of which are in low elevation areas that were historically highly productive.
***	➢ Large information gaps relating to inventory and research (particularly in relation to significance of natural disturbance patterns at stand and landscape level
**	➢ Education and creative partnering (e.g. with local stewardship groups) were listed as ways to increase the effectiveness of restoration projects. ➢ Reference areas should be identified for ecosystems such as the grasslands, ICHdw/xw old growth, and Pa communities where "natural" conditions are rare. ➢ There is a lack of knowledge regarding species/ habitat relationships and impacts of landscape pattern on population viability and species distribution. Is it total pattern or habitat loss that is impacting wildlife populations? There is poor inventory data and poor understanding of species life histories, etc. ➢ Species diversity is not monitored well; Assumptions are made that habitat conservation will address species, but there is little evidence to be confident about this. ➢ Concern regarding continuing degradation outpacing any possible restoration program

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

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
AT	ATp	2,021,603	63	1	21	24
Comments:	➢ AT is inadequately classified/ represented by the BEC system. There are many rare plant species that are unknown (or their locations are unknown). Plant communities are also insufficiently delineated. ➢ At is considered to be a "brittle ecosystem" that is not very resilient so has low ability to withstand development and disturbance pressures.					
Research Needs:	➢ Lack of information on rare plant and communities. ➢ Concern regarding potential susceptibility to climate change. ➢ It is unclear how changes in disturbance patterns have altered the habitat present and the location of the timberline.					
Ecological Priorities:	➢ Recreation activities are showing a high rate of increase with a large geographic extent . Very few areas are not accessible to summer and/or winter traffic. Negative impacts include: direct trampling of flora and disturbance issues to large mammal populations.					

Dry Engelmann Spruce- Subalpine Fir

BECZONE	Variant(s)	Area (ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
ESSF	TOTAL	2,814,488	82	/	14	16
DRY ESSF	TOTAL of dry	1,202,015	/	/		19
	dc1	73,376	/	/		11
	dcp	426	/	/		0
	dk	1,127,277	28	/		20
	dkp	936	/	1		0
Ecosystem Comments:	➢ Higher diversity of disturbance intensities and fire return interval observed within the dry ESSF compared with wet ESSF (as found in a recent study in Waterton National Park). Insufficient classification causes problems for quantification of suitable management regimes.					
Research Needs:	➢ Comparison of the impacts of conventional forestry versus fire disturbance at the stand level – to mitigate the impacts of decreasing stand vigour due to ingrowth.					
Ecological Priorities:	➢ Significant loss of white bark pine (Pa) due to combination of white pine blister rust and fire suppression resulting in effects throughout the ecosystem. Unknown cascading impacts throughout ecosystem: For example, Clarks nutcracker is the major seed vector, and other species (squirrels/ grizzly bears) use seeds as a protein source. Pa should be listed in the CDC as an endangered species, but is still being logged in the East Kootenay. ➢ Heavy increases in recreational use, particularly increasing road and helicopter access are creating disturbances and are having significant negative impacts on mammal populations. ➢ There are significant deviations from natural disturbance patterns in terms of rate and pattern of harvest. The eastern ESSF is less affected due to extensive National Parks, plus extensive inoperable ground. However, ESSF in the Okanagan Highlands is almost 100% operable and has very little/ no parks. Harvesting is causing radical alterations with unknown effects on biodiversity. Known changes in population ranges of large mammals associated with OK highland					

Wet Engelmann Spruce-Subalpine Fir

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
ESSF	TOTAL	2,814,488	82	/	14	16
Wet/ Very Wet ESSF	TOTAL of wet/very wet	1,612,473	/	/		14
	vc	247,369	/	/		10
	wc2	73,844	/	/		10
	wc4	748,685	7	1		15
	wm	3,159	2	/		0
	wcp	539,416	/	1		10
Ecosystem Comments:	➢ Insufficient information on the importance of site series representation for biodiversity. There are large differences in productivity by site series. Low elevation areas are heavily targeted by harvesting, and not protected by current forest policy. These areas are also likely under-represented in protected areas. ➢ Lack of inventory information, particularly re: wildlife species and stand level structural attributes.					
Ecological Priorities:	➢ Extensive loss of productive /operable old growth forest (which will be greatly increased in the future given current policy). ➢ Caribou populations were once extensive – ranges have radically reduced, and continue to shrink for a number of sub populations/ populations. There is inadequate protection for this species which is known to be impacted by disturbance, fragmentation and habitat loss. ➢ Silviculture practices focus on large disturbances and fail to manage for gap dynamics (the predominant natural disturbance). ➢ Extensive increases in recreation-caused disturbance (potentially exacerbating forestry disturbance, and may concentrate in highly sensitive areas and time periods) ➢ Dragon flats represents a rare and unique plant community at the interface of the ESSF and AT is under considerable anthropogenic stress.					

Dry Interior Cedar-Hemlock

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
ICH	TOTAL	2,057,411	75	/	9	7
DRY ICH	TOTAL dry	376,484	/	/		5
	dw	340,366	26	1		6
	xw	36,118	22	/		0
Ecosystem Summary:	➢ Natural disturbance patterns are considerably more complex than represented by the NDT classification system used for management and policy development. Dry ICH sites exhibit the full range of natural disturbances types (1-4) on a local scale (particularly in ICHdw – due to aspect and location). Harvesting of wet sites and riparian areas has lead to the virtual elimination of NDT1 and NDT2 ICHdw sites. ➢ Management to maintain an even timber flow has radically changed both the proportion of the landbase undergoing disturbance at any one time, and the rate of disturbance. Historic fires ignited by early settlers near the turn of the last century make it difficult to interpret natural disturbance data.					
Research Needs:	➢ The impacts of invasive species on populations of red and blue listed plants and plant communities is unknown – and is a particularly issue in this zone which provides habitat for a large number of invasive species, plus a moderate number of listed species (particularly on dry sites).					
Ecological Priorities:	➢ Extensive dam development on major rivers resulted in very dramatic and extensive ecosystem degradation. ➢ Extensive roading and linear corridor development, particularly in the low elevation/ more densely populated areas, have had many negative impacts. ➢ Agriculture and urban development at low elevation has resulted in loss of high value habitat (associated with wetlands or rare species). ➢ Methodical loss of old forest attributes – at both stand and landscape levels. Loss of large riparian ecosystems, and loss of large fire maintained structures. This is exacerbated for White Pine by whitepine blister rust. ➢ Rate and pattern of harvest, including roads, have radically changed historic landscape patterns and seral stage distribution. This has caused many negative impacts, although the relevance of changing habitat pattern (as opposed to only decreasing habitat availability) is unknown. ➢ Invasive species: the ICH (particularly on some drier sites, but throughout the zone) provides highly productive sites for a large number of invasive species. There are relatively few plant communities (particularly on some sites) that have not been impacted.					

Moist Interior Cedar-Hemlock

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
ICH	TOTAL	2,057,411	75	/	9	7
Moist ICH	TOTAL moist	1,323,205	/	/		7
	mw1	132,958	1	/		5
	mw2	921,617	18	/		8
	mw3	50,575	7	/		4
	mk1	218,055	11	1		4
Ecosystem Summary:	➢ For most agents, the highest level of impacts are in the south, decreasing to the north (due to historic patterns of development). However, low elevation areas are highly impacted throughout the zone. ➢ There is a lack of understanding regarding the complexity of natural disturbance types – confusion is increased by settlement burning patterns early in the last century (fire return intervals are disputed).					
Research Needs:						
Ecological Priorities:	➢ Rate and pattern of harvest, including roads, have radically changed historic landscape patterns and seral stage distribution. This has caused many negative impacts, although the relevance of changing habitat pattern (as opposed to only decreasing habitat availability) is unknown. ➢ Methodical loss of old forests and associated attributes at both stand and landscape levels, especially in the ICHmk1, ICHmw2, ICHmw3. There has also been a loss of large riparian ecosystems (from dams), and a particular loss of large stand structures (trees, snags, CWD). ➢ Loss of habitat due to urbanization, agricultural development and private land forestry at low elevations: the impacts are localized and less significant than in the dw. ➢ The loss of white pine (due to white pine blister rust) is extensive through the zone. (White Pine is an ecologically important component of these systems). ➢ Extensive roading and other linear corridor development, particularly in the low elevation/ more densely populations have had many negative impacts. The loss of wetlands is also associated with roads and development. ➢ Invasive species: the ICH (particularly on some drier sites, but throughout the zone) provides highly productive sites for a large number of invasive species. There are relatively few plant communities (particularly on some sites) that have not been impacted.					

Wet interior Cedar-Hemlock

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
ICH	TOTAL	2,057,411	75	/	9	7
Wet ICH	TOTAL wet	357,722	/	/		8
	vk1	99,435	/	/		1
	wk1	258,287	2	/		11
Ecosystem Summary:	➢ These ecosystems were historically characterised by rare stand initiating events and gap dynamics. This type of disturbance led to fairly continuous old growth forest. Current harvesting patterns are such that the areas are now characterised by large openings with no structural retention. The rate of current forest disturbance is dramatically higher than historical levels, resulting in direct habitat loss. ➢ Mica, Duncan and Revelstoke dams flooded valley bottoms leading to a loss of low elevation old growth and extensive loss of highly productive wetlands.					
Research Needs:						
Ecological Priorities:	➢ Extensive loss of specific low elevation habitat types, namely wetlands and ancient forests. ➢ Rate and pattern of harvest, including roads, have radically changed historic landscape patterns and seral stage distribution. Many negative impacts of habitat loss, although the relevance of changing habitat pattern (as opposed to only decreasing habitat availability) is unknown. ➢ Specific loss of caribou habitat.					

Interior Douglas Fir

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
IDF	TOTAL	484,945	130	/	4	1
	dm1	128,401	12	1		0
	dm2	311,513	36	3		1
	unn	24,809	15	1		7
	xh1	20,221	34	/		1
Ecosystem Summary:	➢ The IDF is classified as a NDT4 (fire maintained) ecosystem. ➢ Most of the IDF in this region is found in the East Kootenay trench (IDFdm2) and the Boundary district (IDFdm1). Historic development and fuel suppression have left the IDF with significantly altered stand structures. ➢ The loss of large, fire maintained features is particularly important in this zone.					
Research Needs:	➢ Fire return intervals and stand histories are still largely unknown for most of the region. Few stand reconstruction studies have been done in the trench. Those conducted match up with similar studies in the US, that all point to mixed severity fire regimes. More data is needed on local plant communities, historic fire patterns, and the impacts of restoration efforts.					
Ecological Priorities:	➢ Fire exclusion is believed to have significantly altered plant communities and stand structures across this zone. Fuel loading and ingrowth are considerable problems. However, efforts to restore these ecosystems must consider fuel manipulation and the spread of exotic and invasive species. ➢ Urbanization and land conversion (to ranchettes, golf courses etc) are directly contributing to habitat loss. ➢ Loss of large stand structures from the landbase through harvesting and other developments have lead to the loss of large trees, snags and CWD. ➢ Livestock are damaging riparian and wetland systems through direct trampling and grazing. ➢ There is a lack of inventory and protection of endangered species. A high number of red and blue listed species are found in this region. ➢ Cottonwood ecosystems along the Kootenay River are declining due to range, forestry and dams.					

Ponderosa Pine

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
PP	TOTAL	84,205	64	/	2.4	0
	dh1	13,794	12	7		0
	dh2	70,412	17	4		0
Ecosystem Summary:	➢ The PP is found in the trench and Boundary areas. ➢ The zone was discussed in conjunction with the IDF due to similar issues. However, the PP was considered less resilient than the IDF. Rates of ingrowth are slower and the spread of exotics are more of an issue.					
Research Needs:						
Ecological Priorities:	➢ See IDF. ➢ Access is very important (more so than in the IDF). Roads and off-roading (ATVs) spread invasive species and damage plant communities. ➢ Fire exclusion is believed to have significantly altered plant communities and stand structures across this zone. Fuel loading and ingrowth are considerable problems. However, efforts to restore these ecosystems must consider fuel manipulation and the spread of exotic and invasive species. ➢ Urbanization and land conversion (to ranchettes, golf courses etc) are directly contributing to habitat loss. ➢ Loss of large stand structures from the landbase through harvesting and other developments have lead to the loss of large trees, snags and CWD. ➢ Livestock are damaging riparian and wetland systems through direct trampling and grazing (though note that some areas are well managed, and minimise these negative impacts). ➢ There is a lack of inventory and protection of endangered species. A high number of red and blue listed species are found in this region.					

Montane Spruce

BECZONE	Variant(s)	Area (m ha)	Listed species Red + Blue	Listed communities	Protected areas (%) Province	Region
MS	TOTAL	584,201	63	/	7	9
	dk	464,349	26	/		11
	dm1	119,852	/	/		0
Ecosystem Summary:	➢ The MSdk is found in the East Kootenay above the Trench and in valley bottoms of the Rockies. The MSdm1 is found in the Boundary district in the Okanagan highlands and Monashee Mountains. ➢ There is a long history of harvesting in the MS, particularly for railway ties in the MSdk.					
Research Needs:						
Ecological Priorities:	➢ Loss of old forest and associated stand structures.					

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: - Low resistance to climate change	➢ Evidence from Europe suggests lower elevation plant species are shifting their range and changing AT communities (may be data available from National Park Service) ➢ Concern re glacial retreat (80% of September flow in Columbia are from glacial meltwaters). Changes will have extensive cascading effects through all other ecosystems ➢ AT/timberline interface fires – disturbance regimes and intensities may change with climate change
Access	➢ Rapid increase in summer recreation (particularly heli hiking and ATV use); direct trampling impacts and disturbance of summer range for large mammals ➢ Rapid increase in winter recreation (particularly cat/heli skiing); particular impacts on caribou populations.

Dry Engelmann Spruce-Subalpine Fir

ISSUE	Ecosystem components impacted:
Landscape Level - extensive removal of natural fire disturbance in many areas - harvesting old stands - management paradigm - changes in disturbance intervals	➢ Extensive loss of whitebark pine through fire suppression and white pine blister rust. This species is considered key because it provides a highly nutritious seed source, and is heavily utilised by a number of species (Clarks nutcracker; small mammals; grizzly bear etc). Geographic extent is throughout the ESSF, anywhere with historic populations of whitebark pine. ➢ Fire suppression is causing ingrowth, resulting in increased seral replacement, low recruitment, and higher mortality rates due to blister rust ➢ Harvesting old stands: preferential targeting of large Sx in harvesting is leading to extensive loss of old Sx throughout the zone. ➢ Managers are extending approaches used at lower elevations to the ESSF without recognizing differences between systems, and variation within this ecosystem. In particular, old forest in historic fire refugia are being lost extensively throughout the zone. ➢ Overall: loss of landscape level patterns and variation due to inadequate mimicking of natural disturbance.

ISSUE	Ecosystem components impacted:
Stand Level	➢ Extensive loss of large structural features, particularly spruce stands on productive sites – becoming a rare ecosystem in this landscape.
Direct Habitat Loss	➢ Mining, oil and gas exploration. e.g. in East Kootenays (e.g. flathead valley), creates significant disturbance (soil/ activity etc). Particularly problematic because mining is largely exempt from any environmental protection guidelines.
Range	➢ In Boundary ESSF, cattle grazing extends into the ESSF causing direct trampling of plant communities, spread of non-native species. Grazing also occurring in new Parks in Boundary district, e.g. Dragon flats.
Access - recreation - roads and helicopters	➢ Recreational access and backcountry tenures have increased substantially over the past 5 years: skiing, heli-hiking, ATV's, snowmobiles etc. Recreation conflicts with goats, sheep, caribou (especially in the Purcells), grizzly bears, and wolverine. New guidelines are in place to regulate backcountry tenure, but their effectiveness is questioned. Geographic extent: many / most high elevation areas are under current recreation tenure or have been applied for. The issue is more apparent in the Purcells and Selkirks than in the Rockies due to ease of access throughout these Ranges. ➢ Localised impacts: in particular, high value areas such as Dragon Flats (west Kootenays) : recreational horse use impacting fragile meadows, (impact extends into AT). ➢ Roads and helicopters –in general these are increasing and will have negative impacts on habitat use and perhaps productivity of various mammal populations at high elevations.

Wet Englemann Spruce-Subalpine Fir

ISSUE	Ecosystem components impacted:
Landscape Level - conversion to short rotations / loss of old forest - natural disturbance regimes - harvesting pressure - inadequate scale of management	➢ Extensive loss of old forest due to extensive management using short rotation forestry. Large areas currently remain, though there was concern regarding future scenario, given current policy and planned LU targets for retention of old forest . LUPG and BGB targets were considered inadequate in a system with rare stand initiating events. ➢ Considerable change in natural disturbance patterns: historically, small scale gap dynamics at least as important as stand replacing disturbance, but currently managed almost exclusively using clearcutting. Has both stand level and landscape level impacts. The impacts of changing landscape pattern so dramatically are unknown, however, they are likely to cause changes in land use patterns by wildlife species. Long term impacts are unknown. ➢ Extensive harvesting throughout the zone: Harvesting is expanding and concern was expressed about future impacts. (There was a concern that "operability lines" will become "opportunity lines"). ➢ There is insufficient consideration of fine scale variation within the zone: This is important because current policy does not account for variation within BEC zones. The most productive areas of the ESSF are valley bottoms, and will not be protected by the FPC.
Stand Level - forest health and climate change - lack of inventory information - loss of whitebark pine	➢ Potentially large impact of climate change on this system – (a) may accelerate forest health issues due to reduced mortality of beetle spp; and (b) forest structure will change as spp are pushed along the closed to open forest gradient (which is the largest gradient of forest layers of all ecosystems). There was discussion as to whether temperature or snow depth is the defining factor here, however, there was agreement that there will likely be a significant effect from climate change. ➢ Unknown impacts of stand level changes on biodiversity values: There is a lack of inventory and understanding of species/ habitat relationships. ➢ Whitebark pine is not as pervasive as in the dry ESSF. However, it is present at low and localised abundances and is ecologically important in these areas. Loss of this species here is therefore important (see comments in dry ESSF).
Access	➢ Extensive recreation development as with dry ESSF (see comments above).
Rare Ecosystem Impacts	➢ Dragon Flats (Mt Scaia, Granby headwaters) – negative and increasing impacts of guide outfitters, horses and snowmobiles on this rare herb/shrub community.
Specific Species Habitat	➢ Caribou winter range: extensive impacts due to harvesting and disturbance. There was considerable doubt as to the ability of current policy and approach to management to maintain these southern populations of caribou.

Dry Interior Cedar-Hemlock

ISSUE	Ecosystem components impacted:
Landscape level - Dams - insufficient consideration of natural disturbance patterns - Fire suppression - rate of harvest and landscape pattern - extensive and continued logging of remaining old growth	➢ Extensive dams on many major river systems have major and multiple negative ecosystem impacts: a) extensive loss of cottonwood ecosystems (regeneration problems associated with decreased flooding) ; extensive loss of wetlands; loss of low elevation grasslands. a) change in hydrological regime – reverse of natural water levels in many large river/ lake systems associated with dams – sturgeon and other fish species impacted. Also changed nutrient regimes which impacts other terrestrial spp and trophic cycles ; cascade effects to terrestrial systems (e.g. bears/ fish). b) local climate changes due to larger volumes of water in the winter – changes to vegetation etc. c) flooding has removed lots of high value winter range – especially in Arrow and Pend d'Oreille. e) loss of salmonids and other aquatic spp (e.g. sculpins) which likely lead to loss of other spp (spp used to spawn near Revelstoke - Yellow fins). Due to changes in movement ability and direct loss of historic spawning habitat, d) fish productivity decreased due to changes in nutrient regimes and introduction of myriad shrimp resulting in reduced survivorship of fry and other life history stages. e) soil degradation effects (research by Kat Enns). ➢ Natural disturbance patterns considerably more complex than represented by NDT classification used for management and policy development. Dry ICH sites exhibit wide range of natural disturbances types (1-4) on a local scale (particularly in ICHdw and due to aspect and location differences). Target harvesting and development on productive/ wet sites resulted in almost complete removal of these ecosystems that more closely resembled NDT 1 and 2. Acknowledged complexity due to high tree species diversity and natural disturbance patterns, however consideration that known information is not used to guide management at stand level or landscape level. ➢ Fire suppression particularly on south facing drier sites has caused a) ingrowth, exacerbating forest health issues (e.g. Armillaria and Douglas-fir bark beetle)., and has reduced high value ungulate winter range in localised areas (e.g. Fort Shepard), plus extensive changes in species abundance (from white pine and ponderosa pine to Douglas fir).

ISSUE	Ecosystem components impacted:
Landscape level (continued)	➢ Fundamental change in landscape pattern due to a combination of land tenure and planning (e.g. BGB). Management to maintain an even timber flow has radically changed both the proportion of the landbase undergoing disturbance at any one time, and the rate of disturbance. a) old inventory maps show large forest cover polygons based on fire disturbance, but current management 'slicing' landscape into increasingly small blocks. Lack of reference data on fire patterns (though known to be fire maintained patterns of 10-15yr FRI in some areas. a) hydrological impacts – suggested large changes in hydrology flow due to changes in landscape pattern b) rate of forest turnover – based on BGB an approximation to natural would be <0.5% turnover per year. However, harvesting results in 0.75-1%/ year turnover in the timber harvesting landbase. Conversely, turnover has been dramatically reduced in non-forest landbase areas (due to fire suppression). How does concentrating forest turnover into a small portion of the landbase changes species distribution and population viability? Current planning (Enhanced Resource Development Zones and Innovative Forest Practices Agreements), plus private land harvesting with little regulation are likely to exacerbate these effects further. ➢ Systematic loss of old growth stands and old growth stand structure in this variant: majority of landscape units cannot meet BGB old seral targets – as a combination of historic settlement fires, and harvesting of productive low elevation stands. However, little or no planning in THLB to retain large patches of mature forest – so issue will increase. Lack of representation below variant level in current policy will likely fail to protect the diversity of stand structures and ecosystems.
Stand Level - loss of snags and CWD - management approaches - management of forest health issues - intensive silviculture	➢ Systematic removal of large sized stand structure throughout landscape (a) historic logging exacerbated by current policy – impacting standing live and dead structures, plus coarse woody debris (b) salvage logging considered a large negative impact on standing structures, (c) firewood cutting along roadways (d) heavily exacerbated by WCB regulations. Concern over systematic decrease in large snags and CWD available into the future given current low retention levels. High species diversity in this variant, including high amphibian and reptile diversity, increases the ecological importance of these values here. In European forests, 9 cavity nesting bird species have become extinct due to loss of suitable nesting and foraging habitat. ➢ Inappropriate management approaches: removal of large veteran tree species, historically maintained by fire (large Fd; Lw; Py) resulting in no large structures retained through time.

ISSUE	Ecosystem components impacted:
Stand level (contd)	➢ Mistletoe eradication is removing important habitat – nesting and food supply;. a) loss of genetic diversity in plantations b) free to grow standards are too low – we are eliminating brush stage. c) planting fast growing trees. improved spp d) stocking levels – densities are too high e) increased susceptibility to pests from genetics.
Direct Habitat Loss	➢ Dams; urban, rural and agricultural development. Extensive, but localised loss of important/ rare habitat a) Creston valley – extensive loss of wetlands due to agriculture. b) Trail – fumekill due to smelter impacted large percentage of drier ICH – longterm impacts of heavy metals unknown.
Riparian	➢ hydrology related to roads and dams. Private land agriculture has taken out any low elevation riparian lands not dammed. ➢ cottonwood ecosystems and associated spp (see note under landscape level impacts)
Access	➢ Extensive road infrastructure required to maintain current management objectives - In Nelson FR 59,000 km of roads (calculated using 1990 data). 8000ha of mainline roads in Arrow , many of which are in low elevation areas historically highly productive. There are numerous negative impacts: a) loss of productivity due to permanent road network b) increased potential for landslides across landscape and general hydrology changes c) vectors for non-native spp. d) human access and poaching and other disturbance (e.g. grizzly bear impacts in previously remote valleys) ; e) firewood cutters – data suggests 20% loss of snags by roaded watershed due to firewood cutting.
Rare Ecosystem Impacts	➢ Many listed species in drier ICH – (a) generally in areas highly impacted by dams, or private land; (b) loss of rare cottonwood ecosystems.

ISSUE	Ecosystem components impacted:
Invasive Species	➢ Extensive impact of a large number of non-native species in ICHdw and ICHxw, especially on warm aspects. Combination of noxious species, and non-native non-noxious species. Importance is accelerating – invasive species specialist (regional) has large documentation of the problem though most info is anecdotal, but also uses Permanent Sample Plots and photo records, release records. a) dramatic changes in natural communities as a result of non-native species b) impacts on fire regime: loss of fine fuel and open stands due to dense coverage (egg by knapweed) increases potential for catastrophic fire c) roads are vectors for spread (though species dependent) ; both knapweed and toadflax spread on roads. (d) exacerbated by warming environment – e.g. broom now survives in pockets in this area, which used to be killed by cold winters (e) new species increasing e.g. loosestrife – population on Kootenay Lake is small so far.
Nutrient Cycling Issues	➢ Systematic loss of CWD resulting in changes in long term nutrient cycling, soil structure and ground habitat. Unknown extent, but likely large in riparian habitats within drier ecosystems

Moist Interior Cedar-Hemlock

ISSUE	Ecosystem components impacted:
Landscape Level - loss of old growth - dams - simplification of natural disturbance types - harvest rate	➢ Systematic loss of old growth stands and old growth stand structure in this variant: many landscape units cannot meet BGB old seral targets – from a combination of historic settlement fires, and harvesting of productive low elevation stands. However, there is little or no planning in THLB to retain large patches of mature forest – so the extent of the problem will increase. Lack of representation below variant level in current policy will likely fail to protect the diversity of stand structures and ecosystems. This issue is a high priority in the south of the region, with lower impacts in more northerly areas (mw1) due to historic patterns of harvest. ➢ Extensive change in pattern of harvest, compared with natural patterns of disturbance (see dry ICH for discussion). Management for even timber flow is resulting in extensive and continual human disturbance/ activity across this zone. ➢ Loss of habitat due to dam development, especially in ICHmw3 and ICHmw2, including extensive loss of wetlands from Arrow district. See dry ICH section for more details on impacts. ➢ As with dry ICH, insufficient management to mimic variation in natural disturbance types – resulting in systematic loss of some ecosystem components (e.g. large trees previously maintained by fires) and extensive change in landscape patterns.

ISSUE	Ecosystem components impacted:
	➢ High rate of harvest compared with natural turnover of forest (see dry ICH for details on potential impacts); exacerbated by short rotation forestry extensively truncating succession (shorter period of early seral brush stages; loss of old growth forest).
Stand Level - loss of old forest attributes - spp conversion - truncated succession - lack of 'old growth' differentiation	➢ Systematic loss of large sized structures throughout, particularly a) loss of large sized structures in riparian zones (elimination of the historic huge cedars present at the turn of the century); b) general removal of the largest structures throughout the forest due to a combination of WCB regulations, inadequate wildlife tree policy, inadequate management to natural disturbance patterns (lack of retention of large fire maintained structures – less extensive an effect than in dry ICH). Lack of management for large CWD. ➢ Species conversion: a) extensive loss of western red cedar stands to spruce, b) white pine blister rust is resulting in extensive loss of this ecologically important species. ➢ Truncated succession: a) 'free to grow' guidelines decrease abundance of early seral non-forest habitat (brush), b) old growth structures reduced ➢ Wetter areas have 'ancient' forest (stand age considerably older than individual tree ages), but this is not recognised by policy which defines old growth simply as >250 years old. This poses a potential loss of rare biodiversity values.
Direct Habitat Loss	➢ Some loss of habitat at low elevations due to urbanization/agriculture, though not as large a problem as in drier variants. ➢ Inappropriate management of private forest land may be a larger issue.
Riparian	➢ Local loss and alteration of wetlands throughout this zone due to poor harvest management.
Access	➢ Extensive impacts of increased access to all areas of the moist ICH (though most prevalent in south of Region) a) see dry ICH for more details; b) increased impact of recreation (catskiing and snowmobiling) potentially impacting large mammal populations – travel corridors for animals interrupted, or increased for some species (e.g. wolves) . Rapid expansion in growth in this activity with insufficient regulation.
Specific Species Habitat	➢ Red-listed caribou species are highly impacted by the rate and pattern of harvesting, including associated disturbances due to roads.
Invasive Species	➢ There are a large number of invasive species - especially in ICHmw2 (see dry ICH for details of impacts)

Wet Interior Cedar-Hemlock

ISSUE	Ecosystem components impacted:
Landscape Level - Dams - change in natural disturbance frequency and patterns	➢ Loss of actual individuals during the flooding (e.g. 500 moose) ➢ These ecosystems historically characterised by rare stand initiating events and gap dynamics – a) type of disturbance historically fairly continuous old growth forest, now characterised by large openings with no structural retention; b) rate of current forest disturbance dramatically higher than historical resulting in direct habitat loss (return interval is too low – if even flow harvest patterns in 2 LU in Arrow, get a FRI of 200, and 19% turnover in 40yrs. – check these numbers from sheet). Although substantial areas of old growth forest remain and current impacts on biodiversity are unknown, targets for retention are considerably lower than that predicted by natural disturbance rates for most landscape units. In addition, current policy does not recognise differences in habitat values below variant level, so low elevation highly productive sites will be further denuded of old growth.
Stand Level - spp shifts - lack of recognition and retention of antique forests	➢ Loss of white pine: historically not abundant in this area, but provided rare/ highly productive sites – many areas were flooded, and the remainder harvested. ➢ Inadequate definition of old growth forest – some areas of 'antique forests' (stand age older than individual tree age) not recognised by current policy , and not maintained on the landscape (known unique species of lichens occur in these areas). Little other research completed.
Direct Habitat Loss	➢ Extensive loss of highly productive sites due to dams (wetlands; riparian etc).
Riparian	➢ Extensive hydrologic changes due to dams.
Access	➢ Extensive roading for harvesting in previously little disturbed areas – potential negative impacts on individual species (e.g. caribou) ➢ Very high recreational potential and current development : rapid increase in snow-mobile and heli/ cat skiing operations, plus lodges in remote areas. ➢ Higher natural probability of landslides – exacerbated by high roading density (climate change expected to increase precipitation). (Draft report by P. Jordan on order of magnitude / ha affected by landslides. natural vs. human caused) ➢ Road / railway/ powerline corridors and urbanization generally impact low elevation valleys.
Rare Ecosystem Impacts	➢ Extensive loss of wetlands.

ISSUE	Ecosystem components impacted:
Specific Species Habitat	➢ Caribou – fragmentation and habitat loss. ➢ Wide ranging or OG dependant spp on endangered list ➢ Many species (including furbearers, waterfowl, shorebirds, amphibians, herptiles and fish) are impacted by control regimes of the dams. The operational effects of water level changes are under review as part of the Water Use Planning Process currently underway, however, habitat loss as a result of the dams is not considered in this process. ➢ Waterfowl – huge habitat losses resulting from dams.

Interior Douglas Fir

ISSUE	Ecosystem components impacted:
Landscape Level - fire suppression / lack of disturbance - fragmented thinking – inadequate planning processes - dams - Ecosystem classification problems	➢ Loss of fire disturbance – extensive ingrowth throughout the zone. a) Research, knowledge, and public buy-in are needed to determine: i) how dynamic is the grassland forest interface? and ii) what are the fire disturbance patterns. Few stand reconstruction studies have been done in the trench. Those done match up with similar studies in the US, that all point to mixed severity fire regimes. Despite local differences, the big picture is the same everywhere. There is an opportunity to learn from US studies of plant communities, fuels, and fire suppression. ➢ Ingrowth occurs rapidly in this type of ecosystem (compared to ESSF/ICH) – so large impacts on biodiversity values with cascading effects throughout the ecosystem expected. ➢ Current rate of conversion of stands from grassland/open forest to closed forest on 185000 ha in the trench is estimated 3000ha/yr. When loss of habitat and rate of conversion due to development are considered, the magnitude of the problem increases. ➢ Ingrowth in Boundary District (dm1) is more rapid than in the east due to more productive sites. a) strategies are not integrated for planning, restoration projects, harvesting, burning, grazing, etc. No-one is doing ecosystem management and the effects of those trying to restore systems are undermined by larger policies (AAC/ overgrazing etc). Issues are exacerbated by the tenure system and land ownership patterns. ➢ Local bureaucratic differences are exacerbating environmental impacts: e.g. high impact in Boundary District due to lack of concern locally (compared with Invermere and Cranbrook Districts). ➢ Loss of low elevation productive habitat due to dams at Koocanusa (less extensive than in ICH but high local impact) ➢ The IDFun needs classification.

ISSUE	Ecosystem components impacted:
Stand Level - stand simplification - harvest systems - AAC - soils	➢ There is a long history of development and extensive loss of old structures throughout zone. Almost no areas remain with large open forests like those that existed historically (no reference ecosystems exist). ➢ Highly 'sanitised' forests – no large standing dead trees / coarse woody debris in existing stands ➢ Extensive firewood cutting is exacerbating the combination of harvesting and fire suppression ➢ Inappropriate harvesting approaches are being used 'for restoration'. Roads and landings are being used extensively and unnecessarily, which reduces some of the benefits of current restoration efforts. Need to look at the most ecological and not the cheapest way of harvesting for restoration in order to maintain plant communities. ➢ The trench, in particular, needs economic incentives to market small wood products so large structures required for ecosystem health can be maintained on the landscape (is also NB in ICH dry (e.g. Perry Ridge) and boundary).
Stand level (contd)	➢ There is resistance to apply the AAC to small wood (rather than stands with large trees) in the Trench. Stumpage does not make it profitable to change traditional forestry approaches, which is necessary if restoration is to be successful here. (note: however, beware of overcutting small wood and decreasing site productivity in long term).
Direct Habitat Loss 1) fire suppression 2) urbanization and private land	➢ Due to fire suppression and ingrowth ➢ Rapid development – urbanization, family ranchettes, golf courses, etc are extensive and accelerating. Private lands used to be dominated by ranches which facilitated more grassland conservation than ranchettes etc.
Riparian	➢ Wetlands and riparian areas are impacted by range and settlements.
Range 1) policy incongruency 2) over-grazing 3) loss of remnant plant communities. 4) destruction of wetlands and riparian areas	➢ Trees vs. grazing for commodity production – same ecosystem, different managers and different priorities. a) In a study cited by D. Gayton, it was noted that in 3 different areas, over 3 years, removal of native forage was more than ½ the amount produced. "Take half, leave half" is the general rule. The study found wild and domestic ungulates were taking 60% of the forage. b) Ingrowth increases the impact of overgrazing and increases concentration on a diminishing resource. c) Degradation influences noxious weed spread. ➢ It is estimated that fire ceased 115yrs ago. 80 yrs ago, there was a large flush of Fd that filled in gaps. Now, our ability to respond to understorey changes is limited by the condition of plants: understorey plants are shaded, tiny, and stressed due to Fd shading. Key plants don't re-invade; weeds often do. We are now at the point where the understoreys of the densest stands are bare dirt and moss, not herbs and shrubs. In the trench, there are others that are at the point of having 10-20yrs left before they reach this dire stage. We need to introduce an agronomic spp act now for those stands, or they will turn to bare dirt under the shade of Fd. In choosing restoration sites, we must be smart about selecting candidate areas now and in the future.

ISSUE	Ecosystem components impacted:
Access	➢ ATVs – the area attracts tourists from Alberta and Montana, as well as locals. a) Off-roading is a problem in the trench and in Boundary. It is getting worse in boundary as other land uses (such as roads, forestry and tourism) expand.
Rare Ecosystem Impacts	➢ IDF is a small portion of the NFR, therefore its local value increases.
Invasive Species	➢ Knapweed is spreading rapidly. Old BEC plot records from before the Gilbert Rd was put into Boundary (transects from the 1970s) show no knapweed. Now knapweed is the leading species. ➢ Impacts are an extreme problem in the west; limited in the east. b) Invasive spp limit stand structure restoration options. In the east, they do not restore an area where weeds are poised to fill in the space opened by cutting. b) We are losing grasslands and natural plant communities. ➢ Boundary IDFdm1, ICHxw, etc are "brittle ecosystems" that are considerably harmed by a wide selection of disturbance agents. ➢ We need research about local species to determine ecological amplitudes and responses to disturbance. Some of this information can be gleaned from US manuals on weeds, but lots of the data is not specific enough to this area. We do not know the implications of specific weeds in local ecosystems. It was also noted that there is reluctance to accept data from other regions, particularly southern US where the same weeds may grow, but under different conditions. ➢ There are inadequate inventories of red and blue listed spp. ➢ Although we don't know details, we do know that disturbance leads to weeds and that we need to control weeds by controlling disturbance. ➢ Increasing large scale development (e.g. the new gas pipeline) – will radically increase the spread weeds.
Non-Forest Impacts	➢ ATVs in wetlands ➢ Aaline wetlands are rare and under pressures noted for all wetlands.
Nutrient Cycling Issues	➢ Year round harvesting can cause problems on fine textured soils in the Trench and in Boundary. Soil compaction can be a large problem if harvesting occurs on wet ground. Current extent of this problem is unknown.
Specific Species Habitat	➢ 2nd highest # of listed spp in the province, but smallest zone in region. ➢ Grouse, badger, rattlesnake, sharp-shinned grouse and others.

Ponderosa Pine

ISSUE	Ecosystem components impacted:
See IDF for discussion notes.	➢ Is more significant than IDF in terms of value of attributes – lower, drier, hotter. Habitat characteristics are better for ungulate winter range.

Montane Spruce

ISSUE	Ecosystem components impacted:
Landscape Level 1) fragmentation and patch size (most of this is general) 2) loss of shoulder habitat 3) loss of old seral stages 4) harvest pattern is opposite of natural disturbance regimes 5) spp conversion 6) lack of protected old	➢ Fragmentation in the Okanagan Highlands is an important problem. Current landscape patterns are a result of simplified harvest rules that will have unknown consequences. ➢ Roads and associated harvesting patterns impact fragmentation. Harvesting occurs at a constant rate, with an even distribution. This differs from historic patterns. For example, average fire size in arrow has gone from 50ha to <1ha. ➢ Is landscape pattern or total habitat loss the important issue? The Impacts on wildlife spp are unknown, and likely differ. There is a research need to determine the impacts of harvesting-induced landscape patterns (e.g. spp shifts, changes in spp ranges, etc). The level of residual structure in a patch was also listed as an important factor in this issue. ➢ Ungulates now go from summer to winter range, but skip shoulder ranges due to ingrowth in NDT4/mixed severity fire ecosystems. ➢ loss of stand level structures ➢ Some discussion re: how this impacts specific spp, and how impacts vary by spp. ➢ Harvest riparian and lower elevation Sx were harvested first, followed by Pl on adjacent slopes. The White River valley is a prime example of this pattern in the MSdk. ➢ What was the historic extent of Pl in the trench? Are our management activities changing this? For example, the flathead has Pl, but what would it have looked like without fire suppression (esp. in valley bottoms)? ➢ <3% old forests are protected in the MS.

ISSUE	Ecosystem components impacted:
Stand Level 1) ingrowth 2) fire suppression / Disturbance pattern 3) high-grading in old seral 4) loss of old structure	➢ In Van Egmond's Masters (1989) on ingrowth into the MSdk, a comparison of air photos showed closed forest ingrowth in meadows. Ingrowth occurred on a smaller scale than in the IDF, but 46 of meadows showed signs of ingrowth (These #s are high b/c of the study method – but are still significant due to low representation of open forest). ➢ In NDT4 stand types, fire starts at low elevation and moves up. Mixed fire regimes, with low FRI and low intensity fires as well as stand replacing fires were experienced in the MS. a) is potentially enhancing mountain pine beetle infestations which are leading to an increase in Sx. ➢ Much of the forest classed as old (AC8 or 9) on forest cover maps is not old and was highgraded for railway ties (old is often old stumps). ➢ MS stands naturally had lots of residual structure. Stands have been homogenized due to logging and planting. Spacing patterns (pre-commercial thinning) could increase horizontal heterogeneity as a means of increasing stand structure.
Stand level (contd)	➢ Succession is truncated at both ends: there is no brush stage (due to FTG) and no old forest (due to short rotations). a) The development of old structures in mature stands could be accelerated through retention patterns in current harvesting.
Invasive Species	➢ Noxious weeds are a problem, but less so than in the IDF, PP and ICH dry.

REFERENCES

Bunnell, F.L., 1999. What habitat is an Island? In Forest Fragmentation: Wildlife and Management Implications (J.A. Rochelle, L.A. Lehmann and J. Wisniewski Eds), Koninkliijke Brill NV, Leiden, Netherlands.

Debinski, D.M and R.D. Holt. 2000. A survey and overview of habitat fragmentation experiments. Conservation Biology 14 (2) 342-355.

deMaynadier, P.G. and M.L. Hunter. 2000. Road effects on amphibian movements in a forested landscape. Natural Areas Journal 20: 56 – 65.

FEMAT. 1996. Report of the Forest Ecosystem Management Assessment Team. Forest Ecosystem Management: An ecological, economic and social assessment. Washington DC, 1996-793-171.

Forman R.T.T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annu. Rev. Ecol. Syst. 29:207-231.

Franklin, J., D. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to achieve watershed and forest health. National Wildlife Federation, Seattle, Washington. 46pp.

Goward, T. 1993. Crown of the ICH: epiphytic macrolichens of old growth forests in the interior cedar-hemlock zone. Bioline, Vol. 11, No. 2, Fall/winter 1993. Pages 15-17.

Harrison, S. and J. Voller. 1998. "Connectivity". Chapter 3 in "Conservation Biology Principles for Forested Landscapes. (J. Voller and S. Harrison, Eds) Ministry of Forests, UBC press.

Kyle, C.J. and C. Strobeck. Genetic structure and population fragmentation of North American wolverines (Gulo gulo). In prep.

Machmer, M. and C. Steeger. 1995. The ecological roles of wildlife tree users in forest ecosystems, Land management handbook, Queens Printer, BC.

MacKinnon, A. 1998. Old Growth Forests. In: *Conservation Biology Principles for Forested Landscapes*. (J. Voller and S. Harrison, Eds.) Ministry of Forests, UBC press.

Maser, C. 1990. The Redesigned Forest. Stoddart Publishing Co, Ltd. Canada. 224 pages.

Noss, R. 1996. Protected areas: how much is enough?. In: National Parks and Protected Areas. Pp 91 – 120 in R.G. Wright, ed.. Blackwell, Cambridge, Mass,.

Perry, D.A. 1994. Forest Ecosystems. The John Hopkins University Press. Baltimore.

Province of BC, 1995. Biodiversity Guidebook. Ministry of Forests and Ministry of Environment, Queens Printer.

Schowalter, T.D. 1995. Canopy arthropod communities in relation to forest age and alternative harvest practices in western Oregon. Forest Ecology and Management 78: 115-125

Trombulak, S.C. and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14 (1) 18-39.

Winchester, N.N. 1997. The arboreal superhighway: arthropods and landscape dynamics. The Canadian Entomologist 129: 595-599.

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

Acronym	Meaning
LUCO	Land Use Coordination Office
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. LIST OF PARTICIPANTS

Name	Affiliation	Phone	e-mail	Location
Greg Utzig	Kootenai Nature Investigations	352 5288	guknil@netidea.com	Nelson
Pat Field	MOF	365 8605	pat.field@gems8.gov.bc.ca	Arrow District
Tom Braumandl	MOF	354 6703	tom.braumandl@gems5.gov.bc.ca	Nelson
Rob Walker	Kootenay National Park	347 6155	rob_walker@pch.gc.ca	E. Kootenay
Kari Stuart-Smith	Crestbrook	426 6241	karissmith@crestbrook.com	Cranbrook
Marlene Machmer	Pandion	354 0150	mmachmer@netidea.com	Nelson
Brendan Wilson	Cordillerian	226 7582	wilsonb@netidea.com	Slocan Valley
Dave White	MOF	342 4200	dave.white@gems4.gov.bc.ca	Invermere
Gerry Fox	MELP Habitat	354 6353		Nelson
Maurice Hanson	RMTNRS		highfieldranch@cyberlink.bc.ca	East Kootenay
Kindy Gosel	Columbia Basin Trust	344 7015	kgosal@cbt.org	Golden
Janet Gagne	FRBC		janet.gagne@gems1.gov.bc.ca	Victoria
Rob Gay	FRBC		rob.gay@gems6.gov.bc.ca	Nelson
Don Gayton	SIFERP	354 6244	don.gayton@siferp.org	Nelson
Val Miller	MOF		val.miller@gems7.gov.bc.ca	Nelson
Guy Woods	MELP			Nelson
Mike Panian	MELP			Nelson
Mike Fenger	MELP	387.9779	mike.fenger@gems3.gov.bc.ca	Victoria

Invited (Unable to attend)

Chris Steeger	Pandion	354 0150	csteeger@netidea.com	Nelson
John Bergenski	Independent	422 3566	diverse@rockies.net	E Kootenay
John Krebs	CBFWCP	352 6874	john.krebs@BCHydro.bc.ca	Nelson
Sue Crowley	MELP	342 4290	sue.crowley@gems4.gov.bc.ca	Nelson

APPENDIX 3. MAP OF REGION WITH MAJOR BIOGEOCLIMATIC ZONES HIGHLIGHTED