LOUISIANA-PACIFIC CANADA LIMITED

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Golden, BC

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FOREST STEWARDSHIP PLAN
BACKGROUND DOCUMENT

Golden TSA

LP's FL A17645 and FL A82664

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INTRODUCTION

The preceding document is the Forest Stewardship Plan (FSP) for LP's Forest Licenses (FL) A17645 and A82664 and Shuswap Indian Band's FL A92559 (Non-Replaceable Forest License). The licenses held by Louisiana-Pacific Canada Limited (LP) entitle LP to harvest an annual volume of 263 466 m^3 within the Golden Timber Supply Area (TSA) portion of the Selkirk Forest District. The license held by the Shuswap Indian Band entitles the Band to harvest 100000m^3 over a five-year period within a defined area of LU G21 (Blaeberry). The FSP complies with the requirements for operational plans as described within the Forest and Range Practices Act (FRPA) and the Forest Planning and Practices Regulation (FPPR). The plan will be amended at various times through the course of the approval term by either major or minor amendments.

FOREST STEWARDSHIP PLAN

The FSP is a requirement of the Forest and Range Practices Act (*FRPA*). The plan is a "results" based, broad level plan that shows areas of potential forest development activities that may occur over a period of five years. The plan is approved for a five-year term with no annual updates and may be extended for up to another five years, bringing the total term to ten years. Areas identified on the FSP for development are referred to as FDU's and are described below. The FSP is a vehicle by which the holder of the FSP communicates results and /or strategies that will be used to achieve the resource management objectives set by government under *FRPA* in each FDU. The results and /or strategies that will be employed to achieve the objective are articulated for the FDU/s to which the results and/or strategy pertains.

FOREST DEVELOPMENT UNITS

FDU's are areas where forest practices will occur over the term of this FSP. FDU's have common sets of objectives, results and/or strategies. FDU's in this FSP are located within the Selkirk Forest District.

FDU's are shown on the FSP 1:50,000 scale maps. Within the FDU's are approved CP and RP areas, and FRPA sec. 196(1) and 196(2) cutblocks and roads).

During the term of this FSP, LP may periodically declare areas through a FSP amendment for those cutblocks and roads that are substantially completed and can be measured against the results and/or strategies contained in this FSP. LP will deposit FSP amendments with the district manager, and those amendments will take effect immediately upon submission consistent with *FPPR* sec. 30(1) and (2).

RECREATION ORDERS

The District Manager has approved and put into effect several Orders to Establish Objectives for Recreation Sites and Trails. These orders are included as approved higher-level plans. The areas are listed in Appendix D of the FSP document and indicated on the FSP (1:50,000 scale) maps. Any proposed blocks that fall within the areas identified by these plans will address the approved objectives.

HIGHER LEVEL PLANS

There are two hierarchical levels of planning, higher level plans and operational plans. Higher level plans establish the broader, strategic context for operational plans, providing objectives that determine the mix of forest resources to be managed in an area. Higher level plans in this FSP include the Kootenay Boundary Higher Level Plan and Recreation Orders grandfathered from the FPC era. Operational plans include Forest Stewardship Plans and Site Plans. Where a higher-level plan exists, operational plans must be consistent with that plan.

The Kootenay Boundary Higher Level Plan Order (KBHLPO) as approved on October 26, 2002. The Higher-Level Plan Order was enacted pursuant to Sections 3(1), 3(2) and 9.1 of the FPC Act and

subsequently transitioned to the Land Act via Section 93.8, and, given authority under Section 1 of FRPA. The objectives in the KBHLPO are considered objectives set by government.

The FDUs identified in are required to be consistent with the KBHLPO. In accordance with section 5(1)(b)(ii) of FRPA, the objectives listed in Table 1 do not occur within the FDUs subject to this FSP and therefore do not pertain to this FSP or are subject to 12(7) of FPPR and it is not practicable to specify a result or strategy for the objective.

Table 1. KBHLP Objectives that do not pertain to this FSP

Objective Number	Objective	Rationale
3	Caribou	Objective 3 no longer in effect. Replaced GAR orders #U-3-005 and #U-4-010.
8	Fire Maintained Ecosystem	There are no areas identified as shrub-land, open range, open forest, or NDT 4 in the FDUs.
9	Visuals	Objective 9 is no longer in effect. Established scenic areas are grand parented as objectives set by government under GAR 7 (1) and 7 (2)
10	Social and Economic Stability	Consistent with FPPR sec. 12(7) LP is exempt from specifying results and/or strategies for this objective.

Kootenay Boundary Higher Level Plan Order

Refer to follow link for the higher-level plan order details

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/kootenayboundary-region/kootenayboundary-rlup/kootenayboundary_rlup_fpc_26oct2002.pdf

OBJECTIVES SET BY GOVERNMENT FOR SOILS

The objective set by government for soils is, without unduly reducing the supply of timber from British Columbia's forests, to conserve the productivity and the hydrologic function of soils.

For the objective for soils, LP adopts, as a result/strategy, Section 35 and 36 and consistent with 12(2) of the FPPR as those sections were on the date this FSP was submitted for approval.

Sections 35 and 36 of the FPPR are detailed below.

Section 35 - Soil Disturbance Limits

(1) In this section:

"first agreement holder" means an agreement holder that is not a fibre recovery tenure holder;

"roadside work area" means the area adjacent to a road where one or both of the following are carried out:

(a) decking, processing or loading timber;

(b) piling or disposing of logging debris;

"sensitive soils" means soils that, because of their slope gradient, texture class, moisture regime, or organic matter content have the following risk of displacement, surface erosion or compaction:

(a) for the Interior, a very high hazard;

(b) for the Coast, a high or very high hazard.

(3) An agreement holder other than a holder of a minor tenure or a fibre supply license to cut, which holder is carrying out timber harvesting, must not cause the amount of soil disturbance on the net area to be reforested to exceed the following limits:

(a) if the standards unit is predominantly comprised of sensitive soils, 5% of the area covered by the standards unit, excluding any area covered by a roadside work area;

(b) if the standards unit not is not predominantly comprised of sensitive soils, 10% of the area covered by the standards unit, excluding any area covered by a roadside work area;

(c) 25% of the area covered by a roadside work area.

(4) An agreement holder may cause soil disturbance that exceeds the limits specified in subsection (3) if the holder

(a) is removing infected stumps or salvaging windthrow and the additional disturbance is the minimum necessary, or

(b) is constructing a temporary access structure and both of the following apply:

(i) the limit set out in subsection (3) (a) or (b), as applicable, is not exceeded by more than 5% of the area covered by the standards unit, excluding the area covered by a roadside work area;

(ii) before the regeneration date, a sufficient amount of the area within the standards unit is rehabilitated such that the agreement holder is in compliance with the limits set out in subsection (3).

(4.1) Despite subsections (3) and (4), if a first agreement holder is authorized to carry out timber harvesting in an area and a fibre recovery tenure holder is authorized to carry out timber harvesting in an area that overlaps with the area of the first agreement holder, the agreement holders must not cause the cumulative amount of soil disturbance from all primary forest activities carried out on the area of overlap to exceed 25% of that area.

(4.2) Subsection (4.1) does not apply in respect of any area of overlap occupied by a permanent access structure.

(5) The minister may require an agreement holder to rehabilitate an area of compacted soil if all of the following apply:

(a) the area of compacted soil

(i) was created by activities of the holder,

(ii) is within the net area to be reforested, and

(iii) is a minimum of 1 ha in size;

(b) the holder has not exceeded the limits described in subsection (3) or the holders have not exceeded the limit described in subsection (4.1), as applicable;

(c) rehabilitation would, in the opinion of the minister,

(i) materially improve the productivity and the hydrologic function of the soil within the area, and

(ii) not create an unacceptable risk of further damage or harm to, or impairment of, forest resource values related to one or more of the subjects listed in section 149 (1) of the Act.

(6) An agreement holder who rehabilitates an area under subsection (4) or (5) must

(a) remove or redistribute woody materials that are exposed on the surface of the area and are concentrating subsurface moisture, to the extent necessary to limit the concentration of subsurface moisture on the area,

(b) de-compact compacted soils, and

(c) return displaced surface soils, retrievable side-cast and berm materials.

(7) If an agreement holder rehabilitates an area under subsection (4) or (5) and erosion of exposed soil from the area would cause sediment to enter a stream, wetland or lake, or a material adverse effect in relation to one or more of the subjects listed in section 149 (1) of the Act, the agreement holder, unless placing debris or revegetation would not materially reduce the likelihood of erosion, must

(a) place woody debris on the exposed soils, or

(b) revegetate the exposed mineral soils.

Permanent access structure limits

36 (1) An agreement holder must ensure that the area in a cutblock that is occupied by permanent access structures built by the holder or used by the holder does not exceed 7% of the cutblock, unless

(a) there is no other practicable option on that cutblock, having regard to

(i) the size, topography and engineering constraints of the cutblock,

(ii) in the case of a road, the safety of road users, or

(iii) the requirement in selection harvesting systems for excavated or bladed trails or other logging trails, or

(b) additional permanent access structures are necessary to provide access beyond the cutblock.

(2) If an agreement holder exceeds the limit for permanent access structures described in subsection (1) for either of the reasons set out in that subsection, the holder must ensure that the limit is exceeded as little as practicable.

(3) An agreement holder may rehabilitate an area occupied by permanent access structures in accordance with the results or strategies specified in the forest stewardship plan or by

(a) removing or redistributing woody materials that are exposed on the surface of the area and are concentrating subsurface moisture, as necessary to limit the concentration of subsurface moisture on the area,

(b) de-compacting compacted soils, and

(c) returning displaced surface soils, retrievable side-cast and berm materials.

(4) If an agreement holder rehabilitates an area under subsection (3) (a) and erosion of exposed soil from the area would cause sediment to enter a stream, wetland or lake, or a material adverse effect in relation to one or more of the subjects listed in section 149 (1) of the Act, the agreement holder, unless placing debris or revegetation would not materially reduce the likelihood of erosion, must

(a) place woody debris on the exposed soils, or
(b) revegetate the exposed mineral soils.

OBJECTIVES SET BY GOVERNMENT FOR TIMBER

The objectives set by government for timber are to

(a) maintain or enhance an economically valuable supply of commercial timber from British Columbia's forests,

(b) ensure that delivered wood costs, generally, after taking into account the effect on them of the relevant provisions of this regulation and of the Act, are competitive in relation to equivalent costs in relation to regulated primary forest activities in other jurisdictions, and

(c) ensure that the provisions of this regulation and of the Act that pertain to primary forest activities do not unduly constrain the ability of a holder of an agreement under the *Forest Act* to exercise the holder's rights under the agreement.

The FSP is not required to outline a result or strategy for this objective.

OBJECTIVES SET BY GOVERNMENT FOR WILDLIFE

(1) The objective set by government for wildlife is, without unduly reducing the supply of timber from British Columbia's forests, to conserve sufficient wildlife habitat in terms of amount of area, distribution of areas and attributes of those areas, for

(a) the survival of species at risk,

(b) the survival of regionally important wildlife, and

(c) the winter survival of specified ungulate species.

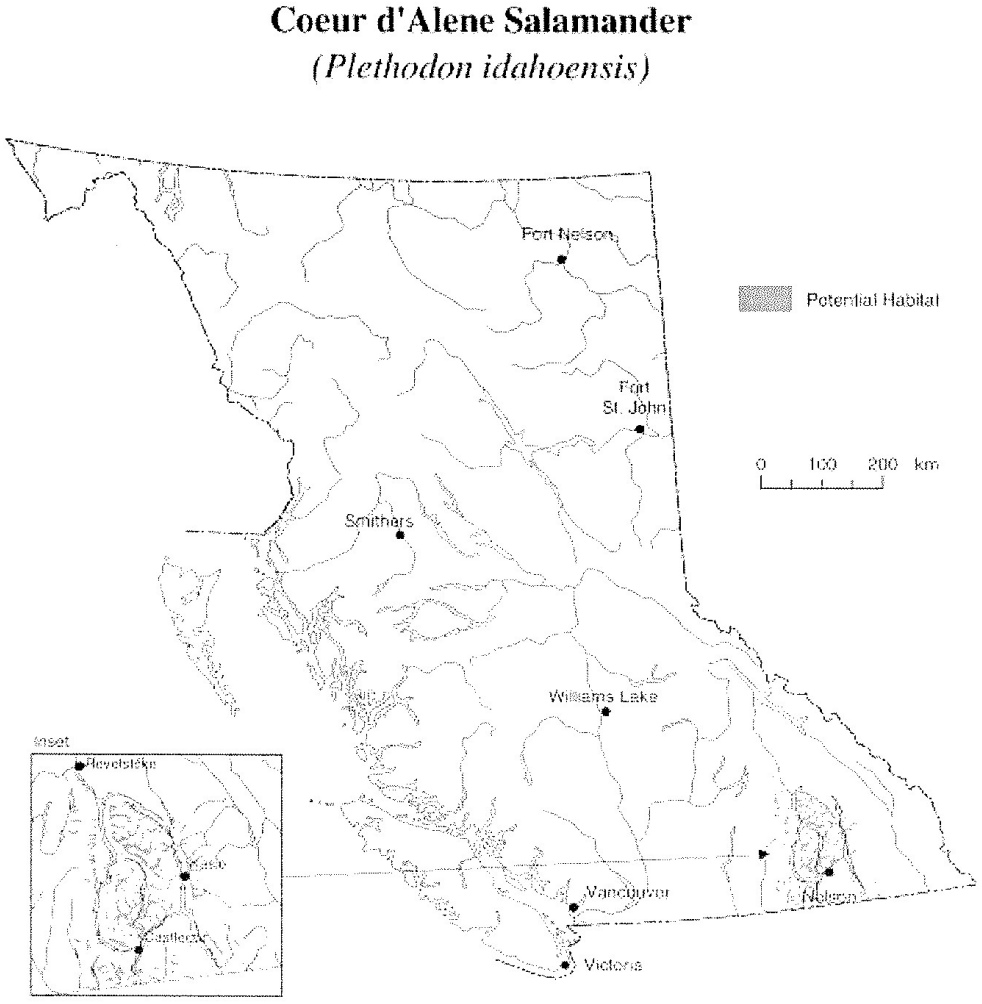
(2) In respect of section 7 of the Forest Planning and Practices Regulation and the notice entitled "Indicators of the Amount, Distribution, and Attributes of Wildlife Habitat Required for the Survival of Species at Risk in the Columbia Forest District", issued in December 2004:

(a) the areas identified on the map "Potential Habitat of Coeur d'Alene Salamander" indicate the potential distribution of the Coeur d'Alene Salamander. Because there is no overlap between potential habitat and the FDUs in this FSP, LP will not be addressing this notice in the text of the FSP document,

(b) LP is exempt to the extent that the Wildlife Habitat Areas # 4-011, 4-014 to 4-017, 4-019 to 4-028, 4-036 and 4-043 addresses the amount included for Coeur d'Alene Salamander in the Notice for the Selkirk Forest District, and

(c) the Wildlife Habitat Areas identified in the GAR Order are outside of the FDUs.

Potential Habitat of Coeur d'Alene Salamander



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several ecosystem classifications (Ecoregion, Biogeoclimatic and Broad Ecosystem Inventory) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated. Recent records (2001, 2002) not included.

BRITISH COLUMBIA

MATERIAL SUPPORTING THE NOTICE, BUT NOT PART OF THE NOTICE.

INFORMATION CONCERNING WILDLIFE HABITAT FOR THE SURVIVAL OF SPECIES AT RISK IN THE COLUMBIA FOREST DISTRICT

This document is intended to provide background information and support to the legal framework of the Notice of indicators of the amount, distribution and attributes of wildlife habitat required for the survival of species at risk in the Columbia Forest District. This document is not part of the legal Notice. Its purpose is to provide additional information for consideration by delegated decision makers and by those persons required to prepare results and strategies consistent with section 7(1) of the Forest Planning and Practices Regulation or act in a manner consistent with section 9(3) of the *Woodlot Licence Planning and Practices Regulation.*

1. BACKGROUND INFORMATION

The 1% impact budget associated with the Identified Wildlife Management Strategy is directed at the short-term timber supply. For the purpose of this Notice the short-term timber supply budget represents the total mature timber harvesting land base (THLB) in age classes older than 80 years. Within the Columbia Forest District the short-term timber supply budget is equal to 1750 ha. Current to August 1, 2004, there are no approved wildlife habitat areas in the forest district. Therefore, the remaining available budget is 1750 ha. Table 1 summarizes the amount of area included in the Notice as well as the amount of area in approved WHAs and their respective impacts to the mature THLB.

Indicators of amount, distribution and attributes included in the Notice are based on existing data, current knowledge of species distribution, inventory efforts, and species biology, including territory size and intraspecific competition. In many cases, comprehensive inventories have not been completed. Where inventory work generates a greater number of known occurrences and suitable habitat, the Notice may be amended to reflect a greater number of anticipated wildlife habitat areas. Any amendment to the Notice will be consistent with the policy direction on timber supply impacts.

Species accounts for each of the species mentioned in the Notice can be obtained from the Identified Wildlife Management Strategy website:
http://wlapwww.gov.bc.ca/wld/identified/iwms2004_index.htm

Table 1. Summary of mature THLB impacts for amounts included in the Notice and approved WHAs in the Columbia Forest District.

Species	Total Area (ha)	Estimated Mature THLB (ha)	Percent of 1% District Budget
Amounts in Notice			
Coeur d'Alene Salamander	60.0	36.0	2.1
Subtotal	**60.0**	**36.0**	**2.1**
No Approved Wildlife Habitat Areas			
Total	**60.0**	**36.0**	**2.1**

Figures and spatial information (shapefiles) to support the amount and distribution statements for species included in the Notices are included in the folders titled "Figures" and "Spatial Data" on the following ftp site:
ftp://ribftp.env.gov.bc.ca/pub/outgoing/cdc_data/Approved_FRPR_sec7_WLPPR_sec9_Notices_and_Supporting_Info/Species_at_Risk/Columbia_FD/Supporting_Info/

Inclusion of draft and proposed Wildlife Habitat Area boundaries in the supporting information does not prejudice the review and comment that may be ongoing around these Wildlife Habitat Areas. Where Wildlife Habitat Areas have not been through the full review and comment process, MWLAP will continue to work with affected parties to address the Wildlife Habitat Area boundaries.

The following section is intended to clarify the amount, distribution and attribute statements in the legal Notice.

1) Coeur d'Alene Salamander (*Plethodon idahoensis*)

Amount:
The amount in the Notice is based on the anticipated need for 6 future wildlife habitat areas for Coeur d'Alene Salamander. Information is available from the Ministry of Water, Land and Air Protection. Estimates of mature timber supply impacts are based on estimates provided in the "Estimated Impact of the Identified Wildlife Management Strategy (Version 2004) on Provincial Timber Supply".

A total of 140 ha (78 THLB), intended to address 14 future WHAs, has been identified as a long-term projection for this species.

Due to data sensitivity concerns locations of draft Coeur d'Alene Salamander WHAs are not provided here. For information on draft WHA boundaries contact the Ministry of Water, Land and Air Protection, Nelson, Ted Antifeau.

2) Grizzly Bear (*Ursus arctos*)

No amount for Grizzly Bear has been included in the Notice as there are no threatened Grizzly Bear population units in the forest district. Where habitat areas that have no mature timber supply impacts are identified with future suitability mapping, the Notice may be amended to include indicators of the amount, distribution and attributes for this species.

3) Lewis's Woodpecker (*Melanerpes lewis*)

Amount:
An amount for Lewis's Woodpecker has not been included in the Notice. This species is known to occur in the district, but there is no current information that would allow an amount, distribution and attributes to be identified. Where inventory work generates known occurrences and suitable habitat, the Notice may be amended to include indicators of the amount, distribution and attributes for this species.

A total of 56 ha, intended to address 2 WHAs, has been identified as a long-term projection for this species in this district.

4) Badger (*Taxidea taxus jeffersonii*)

Amount:
An amount for Badger has not been included in the Notice. This species is known to occur in the district, but there is no current information that would allow an amount, distribution and attributes to be identified. Where inventory work generates known occurrences and suitable habitat, the Notice may be amended to include indicators of the amount, distribution and attributes for this species.

A total of 100 ha, intended to address 2 WHAs, has been identified as a long-term projection for this species in this district.

5) Mountain Caribou (*Rangifer tarandus caribou*)

Amount:
Mountain Caribou has not been included in the Notice. The Kootenay Boundary Land Use Plan High Level Plan contains objectives for the management of Mountain Caribou. For the purpose of planning under FRPA these HLP objectives represent the objective set by government for Mountain Caribou.

Wildlife Habitat Required for the Winter Survival of Ungulate Species

http://www.env.gov.bc.ca/esd/distdata/ecosystems/frpa/Approved_FRPR_sec7_WLPPR_sec9_Notices_and_Supporting_Info/UWR/Timber_Supply_Areas/Golden_TSA/Notice/GoldenTSA_UWR.pdf

Information Concerning Wildlife Habitat for the Winter Survival of Ungulate Species

http://www.env.gov.bc.ca/esd/distdata/ecosystems/frpa/Approved_FRPR_sec7_WLPPR_sec9_Notices_and_Supporting_Info/UWR/Timber_Supply_Areas/Golden_TSA/Supporting_Info/Docs/Supporting_info_GoldenTSA_UWR.pdf

GAR Order – Mountain Caribou Winter Range.

U-3-005 - Revelstoke Shuswap Planning Unit
http://www.env.gov.bc.ca/wld/documents/uwr/u-3-005_order_09Dec09.pdf

U-4-010 – Kinbasket Planning Unit
http://www.env.gov.bc.ca/wld/documents/uwr/u-4-010_order_09Dec09.pdf

LP Golden – FLA82664

DRAFT Kinbasket Operation & Caribou Mitigation Plan

Blocks laid out on Kinbasket Point are in an area located between the Sullivan and Kinbasket Rivers on the east side of the Kinbasket Reservoir. This area is east and south of legally (GAR Order) identified caribou management areas and currently has no legislated caribou requirements. However, Louisiana Pacific (LP) has altered its development plan to reduce the effects of forest harvesting on southern mountain caribou by employing the management practices outlined in this document.

Kinbasket Point lies at boundaries of the Columbia North and Central Rockies herds of southern mountain caribou. The Columbia North herd is considered stable or experiencing a slight population growth based on recent census results, while the Central Rockies herd is considered extirpated from its historic range. Columbia North caribou are known to occupy habitats to the north and east of Kinbasket Point and likely transit this area, but the biogeoclimatic zone and stand characteristics of the site do not represent high value early winter habitat (Terry et al. 2000, Environment Canada 2014)[1]. Southern mountain caribou utilize old forests of predominantly sub-alpine fir, hemlock and western red cedar during the early winter period[1]. These forests are selected for their snow interception, browse species, and access to lichen on fallen trees. This early winter range is occupied until the snowpack at higher elevations increases and becomes supportive enough to allow caribou to reach arboreal lichens at higher elevations. The majority (95-98%) of the timbered land base that overlaps caribou range and FL A82664 is inaccessible to timber harvesting and has very little to no land-based access and thus harvest is not anticipated in those areas. Kinbasket, Tsar and Sullivan River areas are inoperable for timber harvesting, within Old Growth Management Areas (OGMA), or are within the southern mountain caribou GAR winter range.

LP is proposing to harvest approximately 250-350ha in FLA82664 over the next 3-5 years. Of this, 214 hectares makes up the current proposed development. For context, Cummins River Provincial Park (~15km NW of Kinbasket) is over 25,000 ha of undeveloped area. Windy-Austerity (directly across the reservoir) is also a large undeveloped valley - ~15,000 ha. This proposed development amounts to < 0.01% of the forested area in the northern Forest Development Unit

The planned blocks are targeting age class 6-7 with some age class 8 of predominantly Douglas fir stands in the sub-mesic or drier ecosystem associations, mostly on west and south aspects. A field assessment for ungulate habitat suitability revealed that forest composition is Douglas fir dominant, with closed canopies and little understory. Assessment for habitat suitability for all ungulate species suggest these blocks provide only a few requirements for overwintering ungulates – snow interception and thermal cover, but suitable browse species are sparse, with most understory composed of bare ground, or moss. Patches of *Paxistima myrsinites* (falsebox), an important component of the winter diet of ungulates, were sparse with little evidence of browsing. Only one group of deer sp. pellets were

[1] Environment Canada. 2014. Recovery strategy for the Woodland Caribou, Southern Mountain population (Rangifer tarandus caribou) in Canada [Proposed]. Page 68. Ottawa.

Terry, E. L., B. McLellan, and G. S. Watts. 2000. Winter habitat ecology of mountain caribou in relation to forest management. Journal of Applied Ecology:589–602.

found during visits to the blocks. Kinbasket Point currently appears to support only a small number of ungulates, and thus predators. Maintaining this low abundance of ungulates on Kinbasket Point the primary management objective to limit the influx of predators, which could, in turn prey on caribou that may transit the area.
The following outlines (in consultation with FLNRORD and a professional biologist) practices that are designed to suppress ungulate species, and thus limit impacts on the Columbia North herd of southern mountain caribou. These recommendations are implemented for the block layout period, as well as post-harvesting where management objectives are focused on restocking the harvested areas with unpalatable species as quickly as possible. The area is currently not highly suitable for ungulates, and specifically represents low value early winter habitat for caribou. Maintaining this low-quality habitat for moose and deer, while reducing the ability of those species, and associated predators to travel into more core areas of southern mountain caribou range are the goals.

1. **Access**
    a. Restrict public motorized access by adding a barrier near the new bridge installed across the Sullivan River. The bridge is approximately 10km down from the proposed Cutting Permit area. The barrier will be in place when LP is not actively harvesting, hauling, or road building in the Kinbasket Point area.
    b. Deactivate rehabilitate access roads and block trails within cutblocks after harvest. Roads will be deactivated where they are not necessary for post-harvest silviculture activities. Deactivation will include one or more of the following, recontouring, placement of large woody debris, grass seeding, removal of drainage structures, and tree planting. The attached map shows proposed deactivation prescription and timing of deactivation.
    c. Once planting is complete, deactivation of additional roads not required for brushing access will occur.
    d. Grass-seed all road cuts/fills, landings, and ditches susceptible to erosion as soon as roads are built and after harvest. Seeding will occur on an as-needed basis to control erosion but will be limited in area to avoid the establishment of palatable species for moose, deer, and bear species. A modified seed mix specific to this area will be used and is composed of *Bromus marginatus* (Mountain Brome), *Elymus trachycaulus* (Slender Wheatgrass), *Festuca saximontana* (Rocky Mountain Fescue), *Lolium multiflorum* (Annual Ryegrass), and *Poa alpina* (Alpine Bluegrass). These species are of low nutritional value to wildlife and are unlikely to persist as seral succession advances.
    e. Regularly brush roadsides for cottonwood, aspen, willow to ensure species desirable to moose are limited or eliminated.
2. **Cover/Retention**
    a. Block layout has been reconfigured to create mature timber corridors from the reservoir to higher elevations, facilitating elevational movement in natural habitat. This results in a reduction of 75 ha of harvestable timber, which includes older forest classes (age class 9).
    b. Development is limited in areas between the reservoir and the existing Kinbasket mainline to maintain habitat and travel corridors along the reservoir/highwater interface.
    c. Partial cut units:
        i. Changed 15.4 ha from clear-cut to partial cut adjacent to the leave corridors – dropped 2.5 ha that was proposed to go from clearcut to partial cut.
        ii. Target wet sites with high brush potential for partial cut or remove these sites from the proposed blocks. This prescription is intended to reduce the ability of these sites to generate palatable browse. Most of these ‘sites’ have not been included or where removed from the planned harvest areas.
        iii. Leave spruce/hemlock/cedar first for long-term lichen recruitment.
3. **Retain mature deciduous**
    a. In conventional blocks, leave cottonwood, birch, and aspen standing to discourage suckering and subsequent new, palatable growth for ungulates.
4. **Silviculture**
    a. Tree planting to occur first spring after harvest – based on seedling availability. Each seedling has a teabag of fertilizer planted with them to encourage faster growth. This will allow the cutover area to grow conifers faster to out compete palatable browse species for moose and deer.
    b. Explore options with government to increase stocking (decrease inter-tree spacing) of planted conifers. Increased stocking density reduces the ability of palatable species to colonize the area and accelerates the development of unpalatable growth.

c. Brush the planted areas as part of the silviculture regime to achieve free to grow faster and reduce browse favoured by moose.
d. Allow alder to grow along road edges. The alder will restrict establishment of more desirable (to moose) browse species and reduce the ability of predators to travel on these roads.
e. Managing brush along road cuts and landings to discourage browse species.

5. **Reduce time on the landscape -** Minimize harvest time in this area to 3-5 years (or less). The intent of this is to limit human activity to as small of a timeframe as possible. This is a 'get-in/get-out' approach.
6. **Old age classes –** The current proposal largely targets age class 6 and 7 stands (100-140 yrs old). Older Cedar/Hemlock patches have been removed from the planned areas.
7. **Reduce ungulates** – Manage for caribou over the identified Section 7 moose winter range. All efforts will be to discourage moose, deer, and their associated predators.
   Monitor – The site will be monitored annually as vegetation becomes established to ensure management objectives are being met. The proposed management recommendations will be adaptive, so as seral succession occurs, changes to prescriptions such as brushing and stocking densities can be considered to maximize the benefit of these measures for southern mountain caribou.

OBJECTIVES SET BY GOVERNMENT FOR WATER, FISH, WILDLIFE AND BIODIVERSITY WITHIN RIPARIAN AREAS

The objective set by government for water, fish, wildlife, and biodiversity within riparian areas is, without unduly reducing the supply of timber from British Columbia's forests to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas.

In relation to the objective set by government for water, fish, wildlife, and biodiversity set out in section 8 of the Forest Planning and Practices Regulation, the results or strategies that apply to the areas of primary forest activity in each FDU are, the requirements of section 47 to 51 and 53 of the Forest Planning and Practices.

Riparian Management Area Guidebook: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silvicultural-systems/silviculture-guidebooks/riparian-management-area-guidebook

Section 47 - Stream Riparian Classes

(1) In this section, "active flood plain" means the level area with alluvial soils, adjacent to streams, that is flooded by stream water on a periodic basis and is at the same elevation as areas showing evidence of

(a) flood channels free of terrestrial vegetation,
(b) rafted debris or fluvial sediments, recently deposited on the surface of the forest floor or suspended on trees or vegetation, or
(c) recent scarring of trees by material moved by flood waters.

(2) A stream that is a fish stream or is located in a community watershed has the following riparian class:

(a) S1A, if the stream averages, over a one km length, either a stream width or an active flood plain width of 100 m or greater;
(b) S1B, if the stream width is greater than 20 m but the stream does not have a riparian class of S1A;
(c) S2, if the stream width is not less than 5 m but not more than 20 m;
(d) S3, if the stream width is not less than 1.5 m but is less than 5 m;
(e) S4, if the stream width is less than 1.5 m.

(3) A stream that is not a fish stream and is located outside of a community watershed has the following riparian class:

(a) S5, if the stream width is greater than 3 m;
(b) S6, if the stream width is 3 m or less.

(4) Subject to subsections (5) or (6), for each riparian class of stream, the minimum riparian management area width, riparian reserve zone width and riparian management zone width, on each side of the stream, are as follows:

Riparian Class	Riparian Management Area (metres)	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)
S1-A	100	0	100
S1-B	70	50	20
S2	50	30	20
S3	40	20	20
S4	30	0	30
S5	30	0	30
S6	20	0	20

(5) If the width of the active flood plain of a stream exceeds the specified width for the riparian management zone, the width of the riparian management zone is the outer edge of the active flood plain.

(6) The minister may specify a riparian reserve zone for a stream with a riparian class of S1-A if the minister considers that a riparian reserve zone is required.

(7) The riparian reserve zone for a stream begins at the edge of the stream channel bank and extends to the width described in subsection (4) or (6).

(8) The riparian management zone for a stream begins at

(a) the outer edge of the riparian reserve zone, or
(b) if there is no riparian reserve zone, the edge of the stream channel bank,

and extends to the width described in subsection (4) or (5).

Section 48 - Wetland Riparian Classes

(1) Wetlands have the following riparian classes:

(a) W1, if the wetland is greater than 5 ha in size;
(b) W2, if the wetland is not less than 1 ha and not more than 5 ha in size and is in one of the following biogeoclimatic zones or subzones:
  (i) Ponderosa Pine;
  (ii) Bunch Grass;
  (iii) Interior Douglas-fir, very dry hot, very dry warm or very dry mild;
  (iv) Coastal Douglas-fir;
  (v) Coastal Western Hemlock, very dry maritime, dry maritime or dry sub maritime;
(c) W3, if the wetland is not less than 1 ha and not more than 5 ha in size and is in a Biogeoclimatic zone or subzone other than one referred to in paragraph (b);
(d) W4, if the wetland is
  (i) not less than 0.25 ha and less than 1 ha in size and is in a Biogeoclimatic zone or subzone referred to in paragraph (b) (i), (ii) or (iii), or
  (ii) not less than 0.5 ha and less than 1 ha in size and is in a Biogeoclimatic zone or subzone referred to in paragraph (b) (iv) or (v).

(2) Despite subsection (1), an area is to be treated as a single wetland with a riparian class of W5 if

(a) the area contains
  (i) two or more W1 wetlands located within 100 m of each other,
  (ii) a W1 wetland and one or more non-W1 wetlands, all of which are within 80 m of each other, or
  (iii) two or more non-W1 wetlands located within 60 m of each other, and
(b) the combined size of the wetlands, excluding the upland areas, is 5 ha or larger.

(3) Subject to subsections (4) and (5), for each riparian class of wetland, the minimum riparian management area width, riparian reserve zone width and riparian management zone width for the wetland are as follows:

Riparian Class	Riparian Management Area (metres)	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)
W1	50	10	40
W2	30	10	20
W3	30	0	30
W4	30	0	30
W5	50	10	40

(4) No riparian reserve zone or riparian management zone extends onto any enclosed upland areas in a W1 wetland if the wetland is

(a) located in a boreal, subboreal or hyper-maritime climate, and
(b) greater than 1 000 ha in size.

(5) If the minister considers it necessary for a riparian reserve zone or riparian management zone to extend onto an enclosed upland area, the minister may require either or both of the following:

(a) a riparian reserve zone of a width of 10 m or less;
(b) a riparian management zone of a width of 40 m or less.

(6) The riparian reserve zone for a wetland begins at the edge of the wetland and extends to the width described in subsection (3) or (5).

(7) The riparian management zone for a wetland begins at

(a) the outer edge of the riparian reserve zone, or
(b) if there is no riparian reserve zone, the edge of the wetland,

and extends to the width described in subsection (3) or (5).

Section 49 - Lake Riparian Classes

(1) Lakes have the following riparian classes:

(a) L1-A, if the lake is 1 000 ha or greater in size;
(b) L1-B, if
  (i) the lake is greater than 5 ha but less than 1 000 ha in size, or
  (ii) the minister designates the lake as L1-B;
(c) L2, if the lake is not less than 1 ha and not more than 5 ha in size and is located in a Biogeoclimatic zones or subzone that is
  (i) Ponderosa Pine,
  (ii) Bunch Grass,
  (iii) Interior Douglas-fir, very dry hot, very dry warm or very dry mild,
  (iv) Coastal Douglas-fir, or
  (v) Coastal Western Hemlock, very dry maritime, dry maritime or dry submaritime;

(d) L3, if the lake is not less than 1 ha and not more than 5 ha in size and is in a Biogeoclimatic zone or subzone other than one referred to in paragraph (c);

(e) L4, if the lake is

(i) not less than 0.25 ha and not more than 1 ha in size and is in a Biogeoclimatic zone or subzone referred to in paragraph (c) (i), (ii) or (iii), or

(ii) not less than 0.5 ha and not more than 1 ha in size and is in a Biogeoclimatic zone or subzone referred to in paragraph (c) (iv) or (v).

(2) Subject to subsection (3), for each riparian class of lake, the minimum riparian management area width, riparian reserve zone width and riparian management zone width are as follows:

Riparian Class	Riparian Management Area (metres)	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)
L1-A	0	0	0
L1-B	10	10	0
L2	30	10	20
L3	30	0	30
L4	30	0	30

(3) If the minister considers it necessary, the minister may specify a riparian management area and a riparian reserve zone for a lake with a riparian class of L1-A.

(4) The riparian reserve zone for a lake begins at the edge of the lake and extends to the width described in subsection (2) or (3).

(5) The riparian management zone for a lake begins at

(a) the outer edge of the riparian reserve zone, or

(b) if there is no riparian reserve zone, the edge of the lake,

and extends to the width described in subsection (2) or (3).

Section 50 - Restrictions in a Riparian Management Area

(1) A person must not construct a road in a riparian management area, unless one of the following applies:

(a) locating the road outside the riparian management area would create a higher risk of sediment delivery to the stream, wetland or lake to which the riparian management area applies;

(b) there is no other practicable option for locating the road;

(c) the road is required as part of a stream crossing.

(2) If a road is constructed within a riparian management area, a person must not carry out road maintenance activities beyond the clearing width of the road, except as necessary to maintain a stream crossing.

(3) A person who is authorized in respect of a road must not remove gravel or other fill from within a riparian management area in the process of constructing, maintaining or deactivating a road, unless:

(a) the gravel or fill is within a road prism,

(b) the gravel or fill is at a stream crossing, or

(c) there is no other practicable option.

Section 51 - Restrictions in a Riparian Reserve Zone

(1) An agreement holder must not cut, modify, or remove trees in a riparian reserve zone, except for the following purposes:

(a) felling or modifying a tree that is a safety hazard, if there is no other practicable option for addressing the safety hazard;
(b) topping or pruning a tree that is not wind firm;
(c) constructing a stream crossing;
(d) creating a corridor for full suspension yarding;
(e) creating guyline tiebacks;
(f) carrying out a sanitation treatment;
(g) felling or modifying a tree that has been windthrown or has been damaged by fire, insects, disease, or other causes, if the felling or modifying will not have a material adverse impact on the riparian reserve zone;
(h) felling or modifying a tree under an occupant licence to cut, master licence to cut or free use permit issued in respect of an area that is subject to a license, permit, or other form of tenure issued under the Land Act, Coal Act, Geothermal Resources Act, Mines Act, Mineral Tenure Act, Mining Right of Way Act, Petroleum and Natural Gas Act or Pipeline Act, if the felling or modification is for a purpose expressly authorized under that licence, permit or tenure;
(i) felling or modifying a tree for the purpose of establishing or maintaining an interpretative forest site, recreation site, recreation facility or recreation trail.

(2) An agreement holder who fells, tops, prunes, or modifies a tree under subsection (1) may remove the tree only if the removal will not have a material adverse effect on the riparian reserve zone.

(3) An agreement holder must not carry out the following silviculture treatments in a riparian reserve zone:

(a) grazing or broadcast herbicide applications for the purpose of brushing;
(b) mechanized site preparation or broadcast burning for the purpose of site preparation;
(c) spacing or thinning.

Section 52 - Restrictions in a riparian management zone

(2) An authorized person who cuts, modifies or removes trees in a riparian management zone for an S4, S5 or S6 stream that has trees that contribute significantly to the maintenance of stream bank or channel stability must retain enough trees adjacent to the stream to maintain the stream bank or channel stability, if the stream

(a) is a direct tributary to an S1, S2 or S3 stream,

(b) flows directly into the ocean, at a point near to or where one or more of the following is located:
(i) a herring spawning area.
(ii) a shellfish bed.
(iii) a saltwater marsh area.
(iv) an aquaculture site.
(v) a juvenile salmonid rearing area or an adult salmon holding area, or

Table 2. Stream Basal Area Retention Table

Stream Classification			Riparian Management Zone Requirements and Basal Area Retention Strategies		
Fish Bearing Streams	**Non-Fish Bearing Streams**	**Channel Width (m)**	**RMZ Width (m)**	**Windthrow Hazard**	**% Basal Area Retention**
S1-A		>100	100	All	≥20
S1-B		>20	20	All	≥20

S2		5-20	20	All	≥20
S3		1.5-5	20	All	≥20
S4		< 1.5	30	High Medium-Low	≥0 ≥10
	S5	>3	30	High Medium-Low	≥0 ≥10
	S6 **S6**	≤3-1.5 ≤1.5	20	All	≥10 ≥0

Table 3. Wetland Basal Area Retention Table

Wetland Classification		**Riparian Management Zone Requirements and Basal Area Retention Strategies**		
Riparian Class	**Size (ha)**	**RMZ Width (m)**	**Windthrow Hazard**	**% Basal Area Retention**
W1	**>5**	40	All	≥10
W3	**1-5**	30	All	≥10
W5	**Wetland complex[1]**	40	All	≥10

Table 4. Lake Basal Area Retention Table

Lake Classification		**Lake Management Zone Requirements and Basal Area Retention Strategies**		
Riparian Class	**Size (ha)**	**RMZ Width (m)**	**Windthrow Hazard**	**% Basal Area Retention**
L1-A	**> 1000**	0	All	NA
L1-B	**5-1000**	0	All	NA
L3	**1-5**	30	All	≥10

[1]Wetland complexes are two or more adjacent wetlands totaling five hectares or more with overlapping RMA's.

Section 53 - Temperature Sensitive Streams

An authorized person who fells, modifies, or removes trees in a riparian management area adjacent to a temperature sensitive stream, or a stream that is a direct tributary to a temperature sensitive stream, must retain either or both of the following in an amount sufficient to prevent the temperature of the temperature sensitive stream from increasing to an extent that would have a material adverse impact on fish:

(a) streamside trees whose crowns provide shade to the stream;
(b) understory vegetation that provides shade to the stream.

Stream crossings

55 (1) An authorized person who builds a stream crossing as part of a road, a temporary access structure or permanent access structure must locate, build and use the crossing in a manner that

(a) protects the stream channel and stream bank immediately above and below the stream crossing, and

(b) mitigates disturbance to the stream channel and stream bank at the crossing.

(2) An authorized person who builds a stream crossing as part of a temporary access structure must remove the crossing when it is no longer required by the person.

Fish passage

56 (1) An authorized person who carries out a primary forest activity must ensure that the primary forest activity does not have a material adverse effect on fish passage in a fish stream.

(2) An authorized person who maintains a fish stream crossing built after June 15, 1995, must ensure that the crossing does not have a material adverse effect on fish passage.

(3) Despite subsections (1) and (2), an authorized person may temporarily allow a material adverse effect on fish passage to construct, maintain or deactivate a road, including a stream crossing, if

(a) fish are not migrating or spawning, and

(b) the source of the material adverse effect is removed immediately on completion of the construction, maintenance or deactivation.

Protection of fish and fish habitat

57 An authorized person who carries out a primary forest activity must conduct the primary forest activity at a time and in a manner that is unlikely to harm fish or destroy, damage or harmfully alter fish habitat.

Use of livestock in riparian areas

58 An agreement holder who uses livestock for site preparation or brush control for the purpose of carrying out a silviculture treatment must not

(a) construct a livestock corral

(i) in a riparian management area,

(ii) on an area that drains directly into a fish stream or a fish-bearing wetland or lake, or

(iii) on an area in a community watershed that drains directly into a potable water source, or

(b) use the livestock in a riparian management area that is in a community watershed.

Division 4 — Watersheds

Protecting water quality

59 An authorized person who carries out a primary forest activity must ensure that the primary forest activity does not cause material that is harmful to human health to be deposited in, or transported to, water that is diverted for human consumption by a licensed waterworks.

Licensed waterworks

60 (1) An authorized person who carries out a primary forest activity must ensure that the primary forest activity does not damage a licensed waterworks.

OBJECTIVES SET BY GOVERNMENT FOR WILDLIFE AND BIODIVERSITY – LANDSCAPE LEVEL

The objective set by government for wildlife and biodiversity at the landscape level is, without unduly reducing the supply of timber from British Columbia's forests and to the extent practicable, to design areas on which timber harvesting is to be carried out that resemble, both spatially and temporally, the patterns of natural disturbance that occur within the landscape.

In relation to the objective set by government for wildlife and biodiversity set out in Section 9 of the Forest Planning and Practices Regulation, LP adopts as the results or strategies Section 64 and 65 of the FPPR.

Section 64 (1) If an agreement holder other than a holder of a minor tenure harvests timber in a cutblock, the holder must ensure that the size of the net area to be reforested for the cutblock does not exceed

(a) 40 hectares for areas located in the Kootenay Boundary Forest Region, South Coast Forest Region, Thompson Okanagan Forest Region or West Coast Forest Region, as established by the Administrative Boundaries Regulation, and

(b) 60 hectares for areas located in the Cariboo Forest Region, Northeast Forest Region, Omineca Forest Region or Skeena Forest Region, as established by the Administrative Boundaries Regulation.

(2) Subsection (1) does not apply to an agreement holder where:

(a) timber harvesting

(i) is being carried out on the cutblock

(A) to recover timber damaged by fire, insect infestation, wind or other similar events, or

(B) for sanitation treatments, or

(ii) is designed to be consistent with the structural characteristics and the temporal and spatial distribution of an opening that would result from a natural disturbance, and

(b) the holder ensures, to the extent practicable, that the structural characteristics of the cutblock after timber harvesting has been substantially completed resemble an opening that would result from a natural disturbance.

(3) Subsection (1) does not apply if the timber harvesting that is being carried out on the cutblock retains 40% or more of basal area of the stand that was on the cutblock before timber harvesting.

(4) Subsection (1) does not apply if no point within the net area to be reforested is

(a) more than two tree lengths from either

(i) the cutblock boundary, or

(ii) a group of trees reserved from harvesting that is greater than or equal to 0.25 ha in size, or

(b) more than one tree length from a group of trees reserved from timber harvesting that is less than 0.25 ha in size.

Harvesting adjacent to another cutblock

Section 65 (1) In this section:

"adjacent" means an area that is sufficiently close to a cutblock that, due to its location, could directly impact on, or be impacted by, a forest practice carried out within the cutblock;

"existing cutblock" means a cutblock that was previously harvested under an agreement other than a minor tenure;

"new cutblock" means a cutblock on which harvesting has not yet started and that is adjacent to an existing cutblock;

"non-conforming portion" means an area within an existing cutblock on which the stocking and height requirements of subsection (3) have not been met.

(2) An agreement holder other than a holder of a minor tenure must not harvest timber on a new cutblock, unless

(a) all existing cutblocks that are adjacent to the new cutblock meet the requirements set out in subsection (3), or

(b) the combined area of the new cutblock and any non-conforming portions that are immediately adjacent to the new cutblock does not exceed the requirements relating to cutblock size set out in section 64 (1) *[maximum cutblock size]*.

(3) For the purpose of subsection (2) (a), an existing cutblock must meet the criteria set out in one of the following paragraphs:

(a) at least 75% of the net area to be reforested of the existing cutblock is stocked such that the average height of the tallest 10% of the trees on the area is a minimum of 3 m and

(i) is stocked in accordance with the applicable stocking standards, as described under section 16 *[stocking standards]*,

(ii) if the area is on the Coast, other than the Nass timber supply area, is stocked with at least 500 trees/ha of a commercially valuable species that are at least 1.3 m in height, or

(iii) if the area is in the Interior or in the Nass timber supply area, is stocked with at least 700 trees/ha of a commercially valuable species that are at least 1.3 m in height;

(b) the part of the net area to be reforested of the existing cutblock that is closest to the new cutblock

(i) must be at least half of the net area to be reforested,

(ii) is stocked such that the average height of the tallest 10% of the trees on the area is a minimum of 3 m, and

(iii) is stocked

(A) in accordance with the applicable stocking standards for that cutblock, as described under section 16,

(B) if the area is on the Coast, other than the Nass timber supply area, with at least 500 trees/ha of a commercially valuable species that are at least 1.3 m in height, or

(C) if the area is in the Interior or in the Nass timber supply area, with at least 700 trees/ha of a commercially valuable species that are at least 1.3 m in height.

(4) Subsection (2) does not apply if section 64 (2), (3) or (4) apply to the new cutblock.

Patch Size Analysis

Patch Sizes Determined as follows	
V. early seral ≤ 20 yrs (age class 1)	
early seral = 21 -40 yrs (age class 2)	
young = 41 -100 yrs (age classes 3-5)	
mature = 101 - 140 yrs (age classes 6-7)	
older mature = 141 -250 yrs (age class 8)	
old >250 yrs (age class 9)	

Similar age patches < 2 tree lengths or 70m apart – which ever is greater - are grouped as one patch.

OBJECTIVES SET BY GOVERNMENT FOR WILDLIFE AND BIODIVERSITY – STAND LEVEL

Wildlife Habitat Features

LP will endeavor to identify features from the following list and apply the appropriate best management practices for the features. Please note that some of the features are not present in the Golden TSA portion of the Kootenay-Boundary

PROVINCE OF BRITISH COLUMBIA

ORDER OF THE MINISTER OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY: WILDLIFE HABITAT FEATURES IN THE KOOTENAY BOUNDARY REGION

Forest and Range Practices Act

Ministerial Order No. M 213

This order is made under the authority of section 11 (1) of the Government Actions Regulation (B.C. Reg. 582/2004) under the *Forest and Range Practices Act.*

I, George Heyman, Minister of Environment & Climate Change Strategy, and Minister responsible for administration of the *Wildlife Act* in section 154 (2) (a) (ii) of the *Forest and Range Practices* Act, order that the features identified in section 1 are wildlife habitat features in the Kootenay Boundary Region for the purpose of section 11 (1) of the Government Actions Regulation.

This order comes into effect on July 1, 2018.

1 Wildlife Habitat Features

The following to be Wildlife Habitat Features wherever they are found within the Kootenay Boundary Region:

(a) a nest of a Bald Eagle (*Haliaeetus leucocephalus*)
(b) a nest of an Osprey (*Pandion haliaetus*)
(c) a nest of a Flammulated Owl (*Psiloscops flammeolus*)
(d) a nest of a Western Screech-Owl *macfarlanei* subspecies (*Megascops kennicottii macfarlanei*)
(e) a nest of a Great Blue Heron (*Ardea herodias*)
(f) a nest of a Lewis's Woodpecker (*Melanerpes lewis*)
(g) a nest of a Williamson's Sapsucker (*Sphyrapicus thyroideus*)
(h) an American Badger burrow (*Taxidea taxus*)
(i) a Grizzly Bear den (*Ursus arctos*)
(j) a significant mineral lick
(k) a significant wallow
(l) a bat hibernaculum
(m) a bat nursery roost
(n) a hot spring or thermal spring

(This part is for administrative purposes only and is not part of the Order.)

Authority under which Order is made:

Act and section: *Forest and Range Practices Act*, SBC 2002, c 69, s 154, Government Actions Regulation B.C. Reg. 582/2004

Other:

Region.

2 Definitions

(1) Words and expressions not defined in this order have meaning given to them in the *Forest and Range Practices Act*.

(2) In this order,

nest means the nest and its supporting structure that either (1) is currently occupied by a bird species identified in section 1 to hold its eggs or offspring, or (2) is habitually occupied and still capable of holding eggs or offspring of a bird species.

American Badger burrow means an excavated hole that descends below ground that either (1) is currently occupied for denning, shelter or foraging; or (2) is habitually occupied and still capable of providing for denning, shelter or foraging.

Grizzly Bear den means an excavated hole that descends below ground or under a tree root system or is a naturally occurring tree cavity that either (1) is currently used for winter denning, or (2) is habitually used and still capable of providing for winter denning.

significant mineral lick means a naturally occurring mineral lick that is used at least annually by one or more species as evidenced by:

- well-established trails or braided trail systems leading to the mineral lick site,
- extensive excavation or trampling, and/or
- teeth marks, pellets, tracks and hair.

significant wallow means a wallow that is:

(i) used by Moose (*Alces americanus*), Bison (*Bos bison*), Elk (*Cervus elaphus*), Mountain Goat (*Oreamnos americanus*) or Grizzly Bear (*Ursus arctos*); and

(ii) used at least annually by multiple individuals of one or more of the species in (i) as evidenced by well-established trails leading to the wallow, tracks in the wallow, lack of vegetation in the center of the wallow, and/or vegetation disturbed by pawing, trampling, digging or rolling.

bat hibernaculum means a site where one or more bats hibernate in winter.

bat nursery roost means a feature that "houses" an aggregation of female bats and their young.

hot spring or thermal spring means a source of water that is heated geothermally and comes to the surface, as a seep or forming a pool of unspecified size or temperature.

May 29 2018
Date

George Heyman
Minister, Environment and Climate Change Strategy

(This part is for administrative purposes only and is not part of the Order.)

Authority under which Order is made:

Act and section: *Forest and Range Practices Act*, SBC 2002, c 69, s 154, Government Actions Regulation B.C. Reg. 582/2004

Other:

Special Tree Protection Regulation – LP will adhere to the Regulation.

https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/229_2020

Table

Item	Column 1 **Tree**	Column 2 **Location**	Column 3 **Diameter at breast height (cm)**
1	Arbutus	Anywhere	164
2	Cedar, yellow	Anywhere	265
3	Cottonwood, black	In the coastal biogeoclimatic zones	268
4	Cottonwood, black	Outside the coastal biogeoclimatic zones	176
5	Douglas-fir — coastal	Anywhere	270
6	Douglas-fir — interior	Anywhere	160
7	Fir, grand	Anywhere	146
8	Maple, bigleaf	Anywhere	198
9	Oak, garry	Anywhere	136
10	Pine, ponderosa	Anywhere	119
11	Redcedar, western	In the coastal biogeoclimatic zones	385
12	Redcedar, western	Outside the coastal biogeoclimatic zones	290
13	Spruce, Sitka	Anywhere	283
14	Yew, pacific	Anywhere	63

MAPS

Eleven maps of 1:50,000 scale provide all the necessary information. The map identifies the features required by the FPPR (Section 14), where applicable, in effect on the date of submission of this FSP.

Scale 1:50,000

FPPR Requirements displayed on map:

- FDU's North and South
- Ungulate Winter Range: Caribou and Section 7 UWR
- Wildlife Habitat Areas: None
- Fisheries sensitive watershed: None
- Scenic Areas: Visual Polygons
- L1 Lakes: Several throughout each FDU
- Community watersheds: None
- Areas where timber harvesting is prohibited by enactment: Parks, KHMR
- Cutting Permits
- Road Permit roads
- OGMAs (non-legal)

Spatial Deployment of KBHLP Biodiversity –

Caribou Objectives have been replaced by GAR Orders. Only the Biodiversity information is pertinent to the FSP.

SPATIAL DEPLOYMENT OF KBHLP BIODIVERSITY AND CARIBOU OBJECTIVES FOR THE GOLDEN TSA

Documentation of Procedures and Results

Version 1.2

January 17, 2005

Prepared by: Darcy Monchak, R.P.F.

MSRM, Southern Interior Region

Table of Contents

1. INTRODUCTION:

This report documents the procedures and results of the explicit spatial deployment project for old and mature seral biodiversity objectives, and caribou objectives from the Kootenay Boundary Land Use Plan – Higher Level Plan (KBHLP) for the Golden TSA. Data sets were prepared for each of the 29 landscape units in the TSA, and subsequent analysis was used to explicitly spatially deploy those KBHLP requirements. For each landscape unit, there are resultant data files, and hard copy tables and maps that indicate how the KBHLP requirements are attained. Portions of this spatial deployment are recommended to be legalized immediately, to best manage for the objectives. Any such legalization of these spatial objectives should replace those numerical objectives in the KBHLP, providing an adequate replacement policy exists should any of these spatial areas become denuded or otherwise lose their viability to provide for the KBHLP objectives.

2. BACKGROUND:

In some landscape units, draft spatial POGMAs (potential old growth management areas) were derived in the 1990's for the Golden TSA. These areas are still being considered by forest licensees while preparing their Forest Development Plans (FDPs). However, these POGMAs were only based upon partial fulfilment of previous policy objectives for old forests.

The KBHLP was approved for implementation on January 31, 2001. Since then, resource mangers have been managing the old and mature forest, and caribou objectives aspatially (based upon various numerical calculations of the amount of crown forest land base required on the landscape to be maintained in order to achieve the objectives).
There are two main issues with this past aspatial approach to management of these KBHLP objectives:

1) An aspatial approach results in marginal assurance of the quality of the forest stands that will be remaining to satisfy these KBHLP objectives once other forest stands are logged.
   In many landscape units, past or proposed timber harvesting of mature and old forest is at or approaching the current numerical maximum allowed for under the KBHLP (i.e. based upon numerical analysis of the amount of mature or old forest required to be left for biodiversity or caribou KBHLP requirements). If this occurs without adequate evaluation of which stands should be left for biodiversity or caribou KBHLP objectives, there is a higher likelihood that those stands will less adequately provide the landscape or stand attributes required for fulfilment of those objectives.
   This issue presupposes that the terms "conservation of biodiversity", "biological value", and "maintaining viability of existing populations" contained in the KBHLP objectives indicate an ability for resource managers to apply a spatial approach if it better meets the objectives, while meeting the Social and Economic Stability objectives of the KBHLP.

2) An aspatial approach results in less certainty for forest licensees regarding which forest stands can be harvested. Alternatively, explicit spatial identification of old forest, mature forest, and caribou objectives results in immediate identification of the residual forest stands that can more likely be harvested. This is an important asset to assist forest licensees with Forest Development Plan and Forest Stewardship Plan preparation.

3. METHOD:

3.1 DATA

Data source and results for this project are primarily contained in resultant files created and maintained by the Business Design Branch, MSRM. All data used, where applicable, conform to the KBHLP, with the exception that the most recent Biogeoclimatic Classification data was incorporated into the resultant files. These resultant files have been created for each Landscape Unit within the TSA, based upon the most recent data available. There are fields within the resultant file that are used to designate old, mature and

caribou forest deployment. Over time, these planning files may be revised based upon review of updated source information and resources.

Formal metadata for the resultant files have not been completed. Follows is a listing of nomenclature for some of the key fields that exist in the resultant files:

- The resultant files are named "TSA_LU" where "TSA" = "G" for Golden and LU = the specific LU number. This "TSA_LU" is the data file used in Arcview for designation of old, mature and caribou spatial deployment. There are 29 such "TSA_LU" files, one for each of the 29 landscape units in the Golden TSA.

- The TSA_LU resultant contains fields with the most recent 1997 vegetation inventory data.

- The TSA_LU resultant contains fields called cflb (Crown Forest Landbase) and thlb (Timber Harvesting Landbase). Both fields were derived using the vegetation inventory data, and compare closely with that used for TSR3 for the Golden TSA, with minor differences. See Appendix 2 for information.

- The TSA_LU resultant contains fields called SSP_CLAS (Seral Species Classification) and SSP_NUM (Seral Species Polygon Number) which was derived by GIS Section staff based upon set criteria. The SSP_CLAS was derived by combining the seral stage (as per biodiversity guidebook designations) with leading species. The SPP_NUM was derived by a GIS delineation of contiguous leading species and seral stage polygons, with a unique polygon number being given to each contiguous patch (commencing with the number "1"). The intent of these fields was to provide for easy mapping of existing forest cover patches to assist with spatial deployment of old and mature / caribou objectives. In future, it can be used to assist with numbering of old and mature / caribou patches.

- The TSA_LU resultant contains fields called "OSP" (Old Seral Patch) and "MSP" (Mature Seral Patch) which contain the detailed descriptors for categories of recommended old forest areas, as per the following codes:
  - OSP's and MSP's from Parks (as included in, linked to, the specific LU)
    – OSP AND MSP CODE = "A"
  - OSP's and MSP's from non-contributing areas in Connectivity Corridors on slopes < 80 %
    – OSP AND MSP CODE = "B"
  - OSP's and MSP's, unless otherwise noted in the LU deployment table,[1] from non-PI leading contributing areas in Connectivity Corridors on slopes < 80 % (where caribou budget has been explicitly spatially defined, those stands will be chosen first [considered as defacto NC])
    – OSP AND MSP CODE = "C"
  - OSP's and MSP's from spatially defined caribou polygon non-contributing areas outside of Connectivity Corridors (slopes < 80 %)
    – OSP AND MSP CODE = "D"
  - OSP's and MSP's from other non-contributing areas outside of Connectivity Corridors
    – OSP AND MSP CODE = "E"
  - OSP's and MSP's from spatially defined caribou polygons contributing areas outside of Connectivity Corridors
    – OSP AND MSP CODE = "F"
  - OSP's and MSP's, unless otherwise noted in the LU deployment table, from non-PI leading constrained contributing areas (eg. VQO, UWR, CWS, DWS, NDT4 Open forest) outside of Connectivity Corridors
    – OSP AND MSP CODE = "G"

[1] LU Deployment Table – contains numerical documentation of forest cover, forest cover requirement calculations for KBHLP objectives, and associated spatial deployment to satisfy KBHLP objectives.

- OSP's and MSP's, unless otherwise noted in the LU deployment table, from all other non-PI leading contributing areas outside of Connectivity Corridors
  - OSP AND MSP CODE = "H"
- OSP's and MSP's from PI leading contributing areas
  - OSP AND MSP CODE = "I"
- OSP's and MSP's recruited areas
  - OSP AND MSP CODE = "J"

- The TSA_LU resultant contains fields called "POGMA" (Potential OGMA) and PMMA (Potential Mature Management Area). Any area with the above listed (A – J) OSP or MSP codes have a "Y" entered in this field. These fields are somewhat redundant with the OSP and MSP fields, but serve as a confirmation that the polygon is intended for spatial deployment.

- The TSA_LU resultant contains fields called "OSPR" (Old Seral Patch Rank) and "MSPR" (Mature Seral Patch Rank) which have been left blank. The future intent is to use these fields to list rankings of the perceived importance of each patch, based upon the following rankings: "E" = Excellent biodiversity value, "G" = Good biodiversity value, "M" = Moderate biodiversity Value, 'P" = Poor biodiversity value, 'L" = Low biodiversity value.

- The TSA_LU resultant contains fields called "POGMA_NUM" (Potential OGMA Number) and "PMMA_NUM" (Potential PMMA Number) which have been left blank. The future intent is to use these fields to list unique patches. The appropriate data entry made to this field by MSRM planners will be the same as the SSP_NUM, unless different SSPs are being combined, in which case the SSP number of the largest SSP patch will be used.

- The TSA_LU resultant contains fields called "CAR_OLD", "CAR_MAT", and "CAR_PC" which contain the detailed descriptors for categories of recommended old, mature or partial cut caribou spatial deployment as per the following codes:
  - For old or caribou spatial objectives below the caribou line
    - CAR_OLD Code = "BLnc" or "BLthlb", where BLnc = below line in non-contributing forest and BLthlb = below line contributing forest).
    - CAR_MAT Code = "BLnc" or "BLthlb" or "Alnc" or "Althlb", where BLnc = below line in non-contributing forest, and BLthlb = below caribou line contributing forest, Alnc = above caribou line non-contributing forest, Althlb = above caribou line contributing forest.
    - CAR-PC Code = "Y" where the area is designated for partial cutting.

The 29 resultant files have been incorporated into ArcView Project files that include other spatial data necessary for project completion. Besides the TSA_LU resultant theme, the following themes have also been added to the ArcView project view:

1. Seral – Species Theme: using the SSP_Clas field
2. 1999 BEC Variants, except that the ESSFvv variant was incorporated into the ESSFwc2 variant, as the ESSFvv data became available for use only after this project commenced.
3. 100 metre contours (brown line)
4. KBHLP Connectivity corridors (blue line)
5. Operability lines (red line) from the most recent 1999 TSA review
6. Stream features (blue line)
7. Landscape Unit (black line)
8. Previously identified OSPs (where applicable) – (cross-hatched green lines)
9. Orthophotos (where available) or other available imagery.
10. KBHLP Scenic Areas (orange line)
11. 2004 Ungulate habitat and 2004 Caribou Variance to KBHLP habitat (brown line). The 1994 "caribou line" as per the KBHLP was used for all determinations. N ote that as of the data of this report, this

Caribou Variance line is not yet approved by government. Should it not be approved, the caribou spatial deployment may be in error, and will need to be redeployed for some areas.

12. Woodlots and private land areas
13. Avalanche tracks and associated timbered areas, where available
14. Areas logged or designated as A-approved (solid yellow areas) since the vegetation inventory or vegetation update was completed. These areas were attained through submissions from forest licensees, and amalgamated into the resultant file. Since the vegetation inventory is only current to 1997, this provided a number of new disturbance areas to the data, although the information was still incomplete in some instances.
15. Wildfires since 1997. Large wildfire areas were added as a field for certain LUs, and were considered as early seral for the purposes of this project.

Forest cover data for National Park areas date from the 1950's for Glacier and portions of Yoho National Parks, and 2003 for Kootenay National Park and the Ice River portion of Yoho National Park. Data for the 1950's was augmented with more recent fire history analysis completed by Parks Canada. Refer to the LU Deployment Tables for landscape unit specific descriptions of National Park data.

3.2 SPATIAL DEPLOYMENT STRATEGIES / METHODS

Both the Provincial LU Planning Guide and the KBHLP provide direction for deployment of biodiversity old forest requirements. In addition, the KBHLP provides direction for deployment of mature forest biodiversity and caribou forest requirements. Key strategies and methods are discussed below:

3.21 Review of Crown Forest Land Base (cflb)

The cflb was adjusted based upon the following known factors:
Incorporation of any Provincial Park, Ecological Reserve, or National Park areas which are aligned to the TSA for the purposes of biodiversity deployment (not caribou deployment). Such areas have been judged to be part of the same ecological unit as the adjacent TSA areas. This conforms to Section 2.1 (Definitions) of the Landscape Unit Planning Guide. – Appendix 3 contains maps indicating these areas.

TSA LU	LINKED PROTECTED AREA
G01	Hamber Prov. Park
G04	Cummins Prov. Park
G11	Goosegrass Ecol.Re serve
G14	Glacier Nat'l Park – northeast
G16	Marl Creek Prov. Park
G22	Glacier Nat'l Park – southeast
G26	Yoho Nat'l Park (all except Ice River)
G27	Yoho Nat'l Park (Ice River only)
G28	Kootenay Nat'l Park (northern Kootenay River)

Correction of cflb status in the Golden TSA Provincial Forest area due to air photo or other information did not occur as part of this project, except in minor and obvious instances.

3.22 Review of KBHLP Biogeoclimatic Classification (BGC) and Biodiversity Emphasis Options (BEO)

Since the 2001 KBHLP order was approved, more recent BGC linework has been developed for the Golden TSA that has been used for this project. Use of this more recent BGC information has resulted in minor shifts regarding locations of variants in most areas. Since the percentage of old / mature / caribou forest that is required sometimes varies by variant or subzone, this is expected to have resulted in some change to the amount of hectares required from that of the KBHLP. However, this has been subjectively judged to not adversely impact biodiversity resources or timber supply in a major way.

Within the KBHLP, there are four LUs in the Golden TSA that have two BEOs (LUs G21, G22, G26, G28). For those LUs in KBHLP, those BEO lines were designed to correspond to the BGC subzone line, with the exception of LU G21 where the BEO line was designed to correspond to a Ecosection line to better manage for biodiversity resources in that area. For this project, that KBHLP BEO linework migrated to follow the revised BGC linework, with the exception of LU G21, where the original BEO linework was used in order to maintain the intent of the past designation and to maintain past OGMA deployment work as best possible.

3.23 Connectivity Corridors and Grizzly Bear Habitat Areas.

KBHLP connectivity corridors were used for this project. There was no Grizzly Bear Habitat Area data available for use.

3.24 Re-apportionment of Biodiversity or Caribou Objectives Within LUs

For the most part, a minor degree or re-apportioning old, mature or caribou forest area targets among BECs within LUs occurred as part of this project, not warranting any variance to the KBHLP order. However, three exceptions have been noted in the LU Deployment Tables for LUs G01, G02 and G03, and are described in Section 4.

3.25 Calculation of Biodiversity and Caribou KBHLP Targets

As per the KBHLP, old and mature forest biodiversity targets were calculated for each biogeoclimatic variant, and caribou old and mature targets were calculated for each subzone. In all instances, the determined cflb was multiplied by the percentage required as per the KBHLP. For caribou, there were three individual spatial calculations for each subzone: alpine forest, above line caribou and below line caribou requirement.

The targets for the ESSF zone were adjusted if the forest licensee chart area holder indicated that partial cutting would not occur. In such instances, the ESSF target was adjusted upward from 20 % to 30 %. This 10 % increase was intended to account for the 20 % partial cutting that would not occur (based upon an assumed partial cutting scenario of 50 % removal [20 % of 50 % = 10 %]). This was the same assumption used in previous Timber Supply Reviews for the Golden TSA.

The LU Deployment Table documents these calculations – see columns coloured with goldenrod and yellow.

3.26 Determination of Existing Old and Mature Forest

The resultant file contains fields from the 1997 vegetation inventory. More recent disturbance information is listed in the "status" field. The status field is a composite of forest licensee logged and a-approved blocks, updated to 2003, as provided by forest licensees. This information was used to determine the

existing old and mature forest for each variant (for biodiversity) and subzone (for caribou), as per KBHLP direction.

The LU Deployment Table documents these determinations – see columns coloured with blue. Note that this table lists these determinations in a step-by-step sequence of priorities, which were intended to comply with both the KBHLP and the LU Planning Guide. For instance, biodiversity old and mature areas in NC forest in connectivity corridors are listed first, followed by thlb areas in connectivity corridors, followed by NC forest outside of connectivity corridors, etc. The totals for each category include A-approved areas and harvest that has occurred since the vegetation inventory was completed. Those A-approved hectares and harvest that have occurred since the vegetation inventory was completed are listed in subsequent columns.

3.27 Determination of Spatial Caribou Old or Mature Forest Locations

There are eight LUs within the Golden TSA that the KBHLP has designated for Caribou Management (LUs G01, G02, G03, G04, G11, G12, G15, G29). Since forests spatially located to fulfil the KBHLP caribou habitat objectives are considered to be constrained for timber extraction, those areas are also a higher priority for deployment of old and mature forest biodiversity targets as compared to other non-constrained THLB areas. Therefore, for this project, spatial deployment of KBHLP caribou old and mature seral budgets occurred prior to deployment of biodiversity old and mature forest targets to enable biodiversity targets to best overlap with these caribou spatial areas.

In all cases the minimum forest cover requirements as listed in the KBHLP were spatially located, with minor exceptions (eg. for the ICH below line unit, no more than 40 % of the forested area was located). This location of the minimum forest cover was conducted, rather than the alternative approach of locating a higher forest cover, as it is this "minimum" approach that has been the norm for aspatial management of both biodiversity and caribou in the Interior of the Province for over a decade. This "minimum" approach has also been adopted for the last two Timber Supply Reviews for the Golden TSA.

Determination of spatial caribou forest occurred with an emphasis to retain seasonal habitats for caribou in order to contribute to maintaining viability of existing subpopulations. Although forest stand age from the vegetation inventory (resultant file data) was a predominate factor used to determine spatial locations, connectivity between patches (maintaining a sideways "H" pattern on the landscape, size of patches, timber impacts, proximity to telemetry points) were all key factors used. Spatial locations in the non-contributing forest were first evaluated for deployment in order to minimize impacts to timber supply.

Spatial locations were determined for both above line caribou and below line caribou requirements, by subzone. The 1994 "caribou line" as per the KBHLP was used for all determinations.

There were many instances where the exact KBHLP target hectares were not spatially deployed for a given unit. Where these areas are significant (generally > 50 ha), the LU Deployment Table lists their occurrence and rationale. More minor occurrences are not specifically documented, but are obvious from review of the LU Deployment Table numbers.

Where recruitment was required, the general strategy was to select stands that meet targets (eg. age) in the shortest time frame. Other factors such as those listed above were also considered. In some instances, recruitment occurred on slopes > 80 % or in younger stands in order to prevent isolation of thlb and to provide for more contiguous spatial polygons. It is estimated that less than 5 % of all areas spatially deployed as caribou for this project occur on slopes > 80 %.

With few exceptions, A-approved blocks were not selected for spatial caribou deployment, even when in a deficit situation for caribou. This procedure was generally followed because forest licensees have the legal right to harvest these areas via past government approval and avoidance of these areas was necessary in order to expedite this project. Forest licensees were cautious regarding voluntarily removing their A-approved status from these areas due to loss of their investment and timber harvest opportunity. There were a number of instances when A-approved blocks likely occupy more preferred mature or old

forest caribou habitat than those younger stands or areas of > 80 % slope that were recruited. Such areas are a priority for a caribou biologist to review.

There may be some instances where spatial deployment has unintentionally occurred on A-approved areas, due to incomplete A-approved spatial data. However, this is likely minimal due to review of spatially deployed areas with forest licensees. However, in a number of LUs, the spatial deployment deliberately occurs in some A-approved blocks. Such occurrences are noted in the LU Deployment Tables and will require subsequent resolution. Such areas were maintained as spatial caribou for the purposes of this project in order to highlight their perceived importance for maintenance of the herds. These areas, as well as many other proposed spatial caribou areas, require review by a caribou biologist prior to proceeding with any legal designation.

Areas highly fragmented by harvesting and roads were avoided. Isolated areas less than 2 hectares were usually not considered for deployment unless they were located in avalanche paths or other natural clusters. This was considered to be less of an issue above the operability line, as fragmented older patches in these areas sometimes have a greater chance in future of attaining larger size as adjacent stands age.

Spatial deployment was developed using GIS analysis of data. Local knowledge regarding forested areas, the use of orthophotos and advice from a number of resource professionals assisted greatly. Aerial reconnaissance and on-the-ground field checking occurred in a minority of areas. There is uncertainty regarding whether the deployment has been placed in the areas best suited to maintain the viability of existing subpopulations. It is expected that further refinement of this spatial deployment by qualified caribou biologists will occur, including on-the-ground and aerial evaluation. Such evaluation should include analysis of key habitat types as related to slopes and aspect. Such evaluation may result in some significant alterations to the spatial deployment resulting from this project. Until this occurs, it is not recommended that this spatial deployment become a legal entity under the KBHLP.

Spatial deployment occurred with consideration to timber harvest logistics of surrounding thlb areas (i.e. logging system requirements of areas adjacent to spatial caribou or biodiversity patches), but should be looked at in greater detail during operational timber planning. The resultant file does not contain the ATLAS blocking work from the 1990's, which would have better enabled consideration of timber harvest logistics.

3.28 Determination of Spatial Biodiversity Old and Mature Seral Forest Locations

The KBHLP requires that all 29 LUs within the Golden TSA be managed for old forest, and 7 of those LUs are also required to be managed for mature forest values. BEO designations within the KBHLP were followed, with the exception of that listed in Section 3.22.

Old and mature forest areas were determined using the following sequence of priorities (as a general rule), which were intended to comply with both the KBHLP and the LU Planning Guide. Spatial locations in the non-contributing forest were almost always first selected for deployment in order to minimize impacts to timber supply:

I. from Parks (as included in, linked to, the specific LU)
II. from non-contributing areas in Connectivity Corridors on slopes < 80 %
III. unless otherwise noted in the LU deployment table,[2] from non-PI leading contributing areas in Connectivity Corridors on slopes < 80 % (where caribou budget has been explicitly spatially defined, those stands will be chosen first [considered as defacto NC])
IV. from spatially defined caribou polygon non-contributing areas outside of Connectivity Corridors (slopes < 80 %)
V. from other non-contributing areas outside of Connectivity Corridors
VI. from spatially defined caribou polygons contributing areas outside of Connectivity Corridors
VII. unless otherwise noted in the LU deployment table, from non-PI leading constrained contributing areas (eg. VQO, UWR, CWS, DWS, NDT4 Open forest) outside of Connectivity Corridors
VIII. unless otherwise noted in the LU deployment table, from all other non-PI leading contributing areas outside of Connectivity Corridors
IX. from PI leading contributing areas
X. recruited areas, usually conducted in subsequent increments of 20 – 50 years based upon the above sequence of priorities.

In all cases the minimum forest cover requirements as listed in the KBHLP were spatially located, with minor exceptions. This location of the minimum forest cover was conducted, rather than the alternative approach of locating a higher forest cover, as it is this "minimum" approach that has been the norm for aspatial management of both biodiversity and caribou in the Interior of the Province for over a decade. This "minimum" approach has also been adopted for the last two Timber Supply Reviews for the Golden TSA.

Stand age from the vegetation inventory (resultantf ile data) was the predominate factor used to determine which forest stands in categories I. to X. above were suitable. Where there was no incremental impact to the THLB, such factors as interior forest conditions, enhancement of connectivity corridor functionality and road access for nearby commercial timber values were strong considerations regarding deployment. For example, the inclusion of small areas of younger seral stages occurred in some instances where it made sense for conservation, biodiversity or operational timber planning reasons. Also, where there was no incremental impact to the THLB, some areas were not included if they were highly fragmented by harvesting, roads and/or rural development.

Where recruitment was required, the general strategy was to select stands that meet targets (e.g. age) in the shortest time frame - except in instances where deployment outside of these areas would result in better conservation values being attained. Factors such as those listed above were considered. Where there is a choice between similar aged stands, those in connectivity corridor areas were chosen first.

In some instances, recruitment occurred on slopes > 80 % in order to prevent isolation of thlb and to provide for more contiguous spatial polygons. It is estimated that less than 5 % of all areas spatially deployed for biodiversity for this project occur on slopes > 80 %.

[2] LU Deployment Table – contains numerical documentation of forest cover, forest cover requirement calculations for KBHLP objectives, and associated spatial deployment to satisfy KBHLP objectives.

There were many instances where the exact KBHLP target hectares were not spatially deployed for a given unit. Where these areas are significant (generally > 50 ha), the LU Deployment Table lists their occurrence and rationale. More minor occurrences are not specifically documented, but are obvious from review of the LU Deployment Table numbers.

Protected areas (including National Parks) used to achieve biodiversity targets are not part of the Provincial Forest, but are considered to be managed for natural disturbance cycles and part of the crown forest land base supporting biodiversity management. Parks Canada has indicated concern with this approach and considers the use of forested areas in National Parks for biodiversity purposes to be premature, without further discussion at a higher level that also involves other resource management issues. Despite this corporate level uncertainty, Parks Canada staff has contributed expertise regarding their landbase and resource concerns on an LU by LU operational basis.

Inclusion of National Park areas increases the cflb, thereby increasing the old and/or mature area required to be spatially located. Note that spatial old or mature forest biodiversity areas will not be established in National or Provincial Parks or the Goosegrass Ecological Reserve. Rather, where these areas are used to achieve the old or mature growth target for the variant, the actual total of old or mature areas established in the Provincial Forest (i.e. outside of these protected areas) is reduced accordingly.

> Old or mature areas where Parks Canada has strategic or operational plans for prescribed fire or other intervention-based disturbance have not been assumed to provide old or mature forest values (but they remain part of the cflb).
>
> Parks Canada has a "let it burn" policy for many of their areas considered as mature or old forest, enabling the Park to better manage for natural processes. Many of the Park areas considered for this project as old or mature forest are well past their natural disturbance cycle for wildfire, indicating significant wildfires or new plans for prescribed fire may occur in the near future. Old and mature spatial deployment in the TSA should be adjusted in future pending such wildfire occurrence.

Since forests spatially located to fulfil the KBHLP caribou habitat objectives are considered to be constrained for timber extraction, those areas were also a higher priority for deployment of old and mature forest biodiversity targets as compared to other non-constrained THLB areas. Therefore, for this project, spatial deployment of KBHLP caribou old and mature seral budgets has occurred prior to deployment of biodiversity old and mature forest targets to enable biodiversity targets to best overlap with these caribou spatial areas. In some instances, this overlap is not at the 100 % level, due to differences between caribou and biodiversity forest cover requirements.

Old and mature forests were generally used to address the connectivity objective, where possible, except in instances where deployment outside of these areas would result in better conservation values being attained. Note that IGBH areas have not been defined,an d were therefore not considered for this project.

As a general rule, old/mature lodgepole pine within the thlb were a lower priority for deployment for old/mature budgets. These stands were often considered to not have as high biodiversity value as other species of similar age, and are more often a priority for harvest due to forest health concerns. However, non-contributing old Pl stands were chosen for deployment over contributing stands of other species, and such areas should be scheduled for checking of attributes in future.

Areas highly fragmented by harvesting and roads were avoided when timber supply was not impacted. Isolated areas less than 2 hectares were not usually considered for deployment unless they were located in avalanche path or other natural clusters.

Where the age class of the vegetation inventory was found to be in error via field review, the field review information took precedence. However, for this project, a minority of areas were investigated through aerial or on-ground recce's.

Woodlot areas have not been included as part of the cflb, and old or mature forests have not been deployed in these areas as part of this project.

Spatial deployment was developed using GIS analysis of data. Aerial reconnaissance and on-the-ground field checking occurred in a minority of areas. Local knowledge regarding forested areas, the use of orthophotos and advice from a number of resource professionals assisted greatly. It is expected that further refinement of this spatial deployment is required as future on-the-ground and aerial evaluation of these occurs.

Spatial deployment occurred with consideration to timber harvest logistics (logging system requirements, eg. deflection), but should be looked at in greater detail. The resultant file was not able to be created to contain the ATLAS blocking work from the 1990's, which would have better facilitated analysis of timber harvest logistics.

Forest licensee staff, Forest Service staff and past and present Ministry of Water, Land and Air Protection habitat biologists were all key contacts for this project. These groups were contacted on an ongoing basis and were provided with opportunities to review work at important phases of the process. Other stakeholder groups such as the East Kootenay Environmental Society, the Town of Golden and the Rod and Gun Club were given opportunity to consult.

Input from forest licensee staff focused mainly upon commenting on overlap with past or future (a-approved) logging areas. In some instances they provided comment regarding quality of location for biodiversity or caribou.

Input from biologists was not to a level required for this project, particularly concerning caribou – primarily due to a lack of resources. Future work to revise the project spatial deployment should involve more biological expertise.

4. RESULTS and RECOMMENDATIONS – of SPATIAL BIODIVERSITY AND CARIBOU DEPLOYMENT

The LU Deployment Table documents these determinations (see columns coloured with red), and the resultant file contains the spatial results, as described in Section 3.1. Hard copy maps exist in the Golden MSRM office. Note that the LU Deployment Table lists these determinations in a step-by-step sequence of deployment, in order to document compliance with the KBHLP and LU Planning Guide, where applicable. For instance, for biodiversity, old and mature areas spatially deployed in NC forest in connectivity corridors are listed first, followed by thlb areas in connectivity corridors, followed by NC forest outside of connectivity corridors, etc.

For caribou, both the above and below caribou line forest spatial deployment areas are listed. Although subalpine parkland areas have been spatially deployed as part of the resultant file, they are not listed in the LU Deployment Table because they are deployed at the 100 % level (no timber harvesting as per the KBHLP).

In the majority of LUs managed for caribou in the KBHLP, the choices for spatial deployment of caribou were limited due to the degree of past harvest, denudation by wildfire and/or extent of A-approved planned logging areas.

In LUs managed for high and intermediate biodiversity emphasis options, the choices for spatial deployment of caribou were often limited due to the degree of past harvest, denudation by wildfire and/or extent of A-approved planned logging areas. In LUs managed for low biodiversity, there were many choices usually available for deployment.

While use of protected areas has resulted in a higher cflb, and therefore a higher biodiversity budget of spatial old and/or mature forest to be located in applicable LUs, the net result is that less biodiversity budget has been spatially located in the Provincial Forest as compared to if these protected areas were not used.

The general procedure of accepting for spatial deployment isolated areas > 2 ha in some cases reduced interior forest conditions for biodiversity.

Time is of the essence for incorporation of this work into operational forest licensee planning, through either legal or policy means.

It is recommended that the Objective 2 (Old and Mature Forests) of the KBHLP be replaced by the biodiversity spatial deployment from this project. This would result in removal of the Objective 2 forest area seral stage distribution requirements for the Golden TSA, and allow for better management of biodiversity objectives and clarity for forest licensees that would expedite approval of forest development and forest stewardship plans.

It is recommended that the Objective 3 (Caribou) forest cover requirements of the KBHLP not be replaced by the caribou spatial deployment from this project until an adequate biological review of the deployment occurs. Such a review should include analysis of key habitat types as related to slope and aspect, and also include an evaluation of the risk to caribou of the KBHLP direction that this project spatially depicts. Once required changes to the caribou spatial deployment are made, government should proceed with replacement of the existing KBHLP caribou forest cover requirements with the revised caribou spatial deployment. At that time, variance to the KBHLP Objective 3 will be required for six LUs. In three of these LUs, the variance results from a proposed transfer of KBHLP allotments between LUs in the North Columbia Resource Management Zone to enable better management for caribou, biodiversity and recreational objectives (described below). In the other three LUs, the variance results from replacing the partial cut prescription in the ESSF.

Proposed Variance to KBHLP for LUs G01, G02 and G03

LANDSCAPE UNIT	CHANGE REQUIRED	RATIONALE
LU G01	For ICH below the caribou line, change age class 8 or older required to > 51 % from > 30 %	Transfer from LU G03: 256 ha thlb ICH below line caribou > age class 8
LU G01	For ICHwk1, change old seral stage required to 23 % from 19 %	Transfer from LU G02: 116 ha thlb ESSFwc2 old seral forest
LU G02	For ESSFwc2, change old seral stage required to > 16 % from > 19 %	Transfer 116 ha thlb from LU G02 into LU G01 ICHwk1 old seral forest
LU G03	For ICH below the caribou line, change age class 8 or older required to > 25 % from > 30 %	Transfer 256 ha thlb from LU G03 ICH below line caribou > age class 8 forest into LU G01 ICH below line caribou > age class 8 thlb forest
LUs G11, G15, G29	For ESSF – below line, change wording to " Maintain 40 % of the forested area in age class 8 or older. At least one-quarter of this 40 % is to be age class 9".	Replaces the 20 % partial cutting requirement with 10 % in mature forest for areas where partial cutting in not being operationally planned for, as indicated by forest licensee chart holder.

The variance for LU G01, G02 and G03 has been designed to maximize the benefit to biodiversity, timber and remote recreational values in the North Columbia Resource Management Zone. The result is a total of 372 ha of spatial thlb being deployed in LU G01 (Upper Wood River) as either caribou >age class 8 or biodiversity old seral forest, with 372 ha becoming available for harvest in LUs G02 or G03 (removal of spatial caribou and biodiversity deployment from those LUs).

The area of LU G01 where the 372 ha spatial caribou/biodiversity forest is being deployed is north of the Wood River, near the confluence of Pacific / Jeffrey Creeks and the Wood River. This area is currently non-roaded, and is a key backcountry area providing for present and future remote non-motorized recreational values. In addition, this area is in the centre or an important biological connectivity corridor extending from Athabasca Pass (adjacent to Jasper National Park) to Unnamed Creek entering into the Cummins Provincial Park. Deployment of the 372 ha in this area provides for continued management for these values, while enabling timber harvest to occur in more economically preferred and less sensitive areas.

The forest licensee (Wood River Forest Inc.) and EKES (East Kootenay Environmental Society) have promoted and support this variance (See appendix C for letters of support). In addition, this proposal has the support of Parks Canada and has been reviewed by Janis Hooge and (biologist) who has indicated no likely net loss to caribou values.

5. FUTURE WORK

It is expected that continual revision of this spatial deployment will be required, due to better information becoming available regarding stand conditions, subsequent fieldwork, forest licensee operational planning, and natural disturbance.

- Regarding stand conditions, as plantations and other areas mature, areas may be switched, to lessen timber isolation and provide for larger patch sizes and interior forest conditions.
- Regarding fieldwork – there is a concern that insufficient resources were available for ground and aerial evaluation of spatially deployed areas. Field checking of key spatially deployed areas is recommended, along with designation in the resultant file of the type of checking completed.

Old and mature seral patch numbers were not assigned as part of this project, due to time constraints. In future the resultant fields "POGMA_NUM" and "PMMA_NUM" (Potential PMMA Number) should be used to list unique patch numbers.

It was not an objective of this project to evaluate the appropriateness of the KBHLP objectives. However, the spatial deployment of the KBHLP objectives from this project is a prime candidate for evaluation of biological and social and economic impacts of the KBHLP.

Although the calculation of biodiversity and caribou KBHLP targets completed as per Section 3.25 were done with the best information available, peer review of this work has not been completed, aside from cursory review from forest licensees. A check of these calculations is recommended to occur.

Guidelines (policy) will have to be confirmed regarding methodology for revision / replacement should the spatial deployment from this project become policy or legal.

In Low Biodiversity areas, a recruitment strategy is required describing how the full old forest target will be achieved by the end of the third rotation. Work on this strategy has not been a priority, due to lack of resources, but is recommended to be competed in the near future.

6. DATA ISSUES

The metadata file (see Appendix B) for this project is incomplete.

There are roads in some resultants (e.g. LU G13) that are improperly spatially located, perhaps due to NAD shift inconsistency.

Two woodlots in the resultant file for LU G23 do not exist.

Some UREPs (ownership 61-C) are NC (denoted as non-contributing forest rather thlb).

Forest cover inventory for National Parks is often severely outdated.

OBJECTIVE SET BY GOVERNMENT FOR VISUAL QUALITY

The objectives set by government for visual quality are enacted by the Government Actions Regulation Sections 7 (1) and 7 (2) and read as follows:

Visual Quality Objective Order

(Made under Section 7(2) of the Government Actions Regulation B.B. Reg. 582/2004)

I, Garth Wiggill, the District Manager for the Selkirk Forest District, having been delegated by the Minister of Forests, Lands and Natural Resource Operations to exercise his functions under Sections 7 (1) and 7 (2) of the Government Actions Regulation, on this twentieth day of November, 2014, order that the following scenic areas and visual quality objectives (VQOs) are established for the Golden Timber Supply Area:

1. The scenic areas and VQOs indicated on the attached map titled 'Revised Visual Quality Objectives - Golden TSA' map and dated November 19, 2014.

These scenic areas and VQOs cancel and replace any scenic areas and VQOs that were previously established for this area under the Forest Practices Code and continued under the Forest & Range Practices Act.

Garth Wiggill, District Manager
Selkirk Forest District

November 20, 2014
Date

Attachment: 'Revised Visual Quality Objectives - Golden TSA' map dated November 19, 2014

LP will be guided by the definitions of the VQO classes found in FPPR section 1.1, and MFLNRO documents related to visual design. The Visual Impact Assessment Guidebook can be found at the following website http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/visual/Httoc.htm.

OBJECTIVE SET BY GOVERNMENT FOR CULTURAL HERITAGE RESOURCES

The objective set by government for cultural heritage resources is to conserve, or, if necessary, protect cultural heritage resources that are

(a) the focus of a traditional use by an aboriginal people that is of continuing importance to that people, and

(b) not regulated under the *Heritage Conservation Act*.

OBJECTIVES IN RESPECT OF SENSITIVE WATERSHEDS

No Sensitive Watersheds have been established under the Government Actions Regulation or grand-parented under section 180 and 181 of the *Forest and Range Practices Act* that apply to the FDUs of this forest stewardship plan.

OBJECTIVES IN RESPECT OF COMMUNITY WATERSHEDS

No Community Watersheds have been established under the Government Actions Regulation or grand-parented under section 180 and 181 of the *Forest and Range Practices Act* that apply to the FDUs of this forest stewardship plan.

FISHERIES SENSITIVE WATERSHED OBJECTIVES

No fisheries sensitive watersheds have been established under the Government Actions Regulation or grand-parented under section 180 and 181 of the *Forest and Range Practices Act* that apply to the FDUs of this forest stewardship plan.

INVASIVE PLANTS

The Priority Invasive plants for LP's FDUs are as listed on the following website:
https://columbiashuswapinvasives.org/wp-content/uploads/2021/05/Golden-IPMA-Priority-Plant-List.pdf

LP will focus on the Priority "2" and "3" species as the Priority "1" are not currently known in the area under this FSP. The lower priority plants will be recorded on Site Plan documents.

2021 Columbia Shuswap Regional District Priority 2 and 3 plants

ERADICATION or ANNUAL CONTROL – Species are known in the IPMA but with limited distribution and/or significant potential to spread. Management objective is to control sites annually.		
- Baby's breath - Blueweed - Bohemian knotweed - Common Tansy - Cypress spurge - Diffuse knapweed (BC)	- Hoary alyssum - Japanese knotweed - Knapweed spp. (BC) - Leafy spurge (BC) - Meadow knapweed (BC)	- Poison hemlock - Policeman's helmet - Scentless chamomile (BC) - Spotted knapweed (BC) - Teasel
CONTAINMENT – Species are abundant (with no expectation of eradication) in certain portions of the IPMA but have not yet infested all potential habitats. Containment is the management objective. Treat all sites outside of containment lines.		
Contain to gardens: - Butterfly bush - Common periwinkle - English holly	- English ivy - Garden yellow loosestrife - Goutweed - Mountain bluet	- Russian olive - Salt cedar/ Tamarisk - Siberian elm

LP is utilizing information and resources provided by the Columbia Shuswap Invasive Species Society in identifying and managing invasive plant species. This list is subject to change from time to time. Any updates to the Golden IPMA Priority Plant List that occur during the life of this FSP will be considered part of the FSP

Invasive Plant Regulation – Plant List
http://www.bclaws.ca/Recon/document/ID/freeside/18_2004

STOCKING STANDARDS BACKGROUND INFORMATION

Vole Damage to Plantations – Documentation/Study verifying Stocking Standard

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Forest Sciences
Faculty of Forestry
3rd Floor, Forest Sciences Centre
3041 – 2424 Main Mall
Vancouver, B.C. Canada V6T 1Z4
Tel: (604) 822-2507 Fax: (604) 822-9102

January 25, 2010.

Mr. Scott King,
Louisiana-Pacific Canada Ltd.,
P.O. Box 170,
Golden, BC
V0A 1H0

Dear Scott:

Re: Vole damage to planted trees in Glenogle, Roth, and Palliser Drainages

This letter confirms our various discussions and study results outlining the high populations of voles (primarily the long-tailed vole, *Microtus longicaudus*) in the Glenogle, Roth, and Palliser drainages east of Golden.

At 3-4 years post-clearcut harvesting is a critical time for population buildups of voles and subsequent damage to plantation trees. Clearcuts and their associated vegetative development provide conditions for high populations of voles. Thus, during the period 2000 to 2007 in Glenogle and Roth Creeks, and now (2009-2010) in Palliser Creek, vole numbers reached levels high enough to drive plantations to NSR status, thereby requiring re-planting of units.

Voles prefer to feed on lodgepole pine and Douglas-fir seedlings. Spruce, larch, and subalpine fir, in that descending order, are less preferred food sources. Thus, where appropriate, these alternate species could be planted and should be less damaged than lodgepole pine or Douglas-fir.

I hope this outline provides sufficient information on feeding damage to planted trees and some options for regeneration. Please let me know if I may be of further assistance.

Yours sincerely,

Thomas P. Sullivan
Professor
E-mail: tom.sullivan@ubc.ca

GOLDEN STUDY 2009 JOLLY-SEBER POPULATION ESTIMATES

	05-May-09	03-Jun-09	26-Aug-09	23-Sep-09		
Grid C	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi				1.00	1.00	0.25
Microtus longicaudus	1.00	0.00	0.00	0.00	1.00	0.25
Microtus pennsylvanicus	0.00	0.00	0.00	0.00	0.00	0.00
Peromyscus maniculatus	5.00	7.50	32.00	13.00	57.50	14.38
Phenacomys intermedius					0.00	0.00
Sorex sp.					0.00	0.00
Tamias ameoenus	3.00	7.50	4.70	3.00	18.20	4.55
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**9**	**15**	**36.7**	**17**	**77.70**	**19.43**
Grid D	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi	0.00	0.00	0.00	0.00	0.00	0.00
Microtus longicaudus	0.00	0.00	0.00	0.00	0.00	0.00
Microtus pennsylvanicus					0.00	0.00
Peromyscus maniculatus	5.70	6.80	14.00	20.00	46.50	11.63
Phenacomys intermedius	0.00	0.00	0.00	1.00	1.00	0.25
Sorex sp.					0.00	0.00
Tamias ameoenus	19.30	7.50	10.70	9.00	46.50	11.63
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**25**	**14.3**	**24.7**	**30**	**94.00**	**23.50**
Grid E	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi	0.00	0.00	1.00	2.00	3.00	0.75
Microtus longicaudus	1.00	0.00	1.00	1.00	3.00	0.75
Microtus pennsylvanicus	0.00	0.00	0.00	3.00	3.00	0.75
Peromyscus maniculatus	12.00	12.00	17.00	21.00	62.00	15.50
Phenacomys intermedius	0.00	0.00	0.00	0.00	0.00	0.00
Sorex sp.					0.00	0.00
Tamias ameoenus	0.00	2.00	1.00	0.00	3.00	0.75
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**13**	**14**	**20**	**27**	**74.00**	**18.50**
Grid F	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi	0.00	0.00	0.00	0.00	0.00	0.00
Microtus longicaudus	2.00	2.00	0.00	9.00	13.00	3.25
Microtus pennsylvanicus					0.00	0.00
Peromyscus maniculatus	10.20	8.00	9.80	19.00	47.00	11.75
Phenacomys intermedius	0.00	0.00	1.00	0.00	1.00	0.25
Sorex sp.					0.00	0.00
Tamias ameoenus	5.00	7.00	9.60	7.00	28.60	7.15
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**17.2**	**17**	**20.4**	**35**	**89.60**	**22.40**
Grid J	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi	2	0	0	3	5.00	1.25
Microtus longicaudus	1	0	0	1	2.00	0.50
Microtus pennsylvanicus					0.00	0.00
Peromyscus maniculatus	5	1	4	9	19.00	4.75
Phenacomys intermedius					0.00	0.00
Sorex sp.					0.00	0.00
Tamias ameoenus	4	4	5	4	17.00	4.25
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**12**	**5**	**9**	**17**	**43.00**	**10.75**
Grid K	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi	0	0	0	1	1.00	0.25

Grids C, D, E = Clearcut Harvesting

Grids J, K, L = Variable Retention Harvesting

GOLDEN STUDY 2009 JOLLY-SEBER POPULATION ESTIMATES

	05-May-09	03-Jun-09	26-Aug-09	23-Sep-09		
Microtus longicaudus	0	0	0	2	2.00	0.50
Microtus pennsylvanicus					0.00	0.00
Peromyscus maniculatus	21.3	23.4	19.4	26	90.10	22.53
Phenacomys intermedius					0.00	0.00
Sorex sp.					0.00	0.00
Tamias ameoenus	5	5	2	2	14.00	3.50
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**26.3**	**28.4**	**21.4**	**31**	**107.10**	**26.78**
Grid L	**831**	**835**	**847**	**851**	**total**	**mean**
Clethrionomys gapperi	0	0	0	1	1.00	0.25
Microtus longicaudus	0	0	0	0	0.00	0.00
Microtus pennsylvanicus	0	0	2	3	5.00	1.25
Peromyscus maniculatus	4	1	5	15	25.00	6.25
Phenacomys intermedius					0.00	0.00
Sorex sp.					0.00	0.00
Tamias ameoenus	2	8	5	2	17.00	4.25
weasel					0.00	0.00
Zapus princeps					0.00	0.00
Total	**6**	**9**	**12**	**21**	**48.00**	**12.00**

1.0 Title: Vole feeding damage and forest plantation protection in the Golden TSA: Susceptibility of new plantations

PHASE 4

Grass Habitat, Vole Populations and Tree Damage in Forest Plantations

Contract No. 9015003

Annual Report Submitted to:

LOUISIANA-PACIFIC CANADA Ltd.
P.O. Box 170, 800 9th Street North
Golden, B.C.
V0A 1H0

Forest Investment Account
2009-10

Applied Mammal Research Institute
11010 Mitchell Avenue,
Summerland, B.C.
V0H 1Z8

Principal Investigator:

Dr. Thomas P. Sullivan
sullivan@telus.net

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2.0 Executive Summary

This report summarizes an FIA-sponsored program with Louisiana-Pacific Canada Limited in 2009-10 that was focused on the impact of grass-seeded habitat on vole populations in forest plantations. The program is concerned with voles of the genus *Microtus* which are major mammalian pests in coniferous tree plantations in the Golden TSA. Voles feed on tree seedlings and saplings, particularly during winter months of peak years in abundance. This damage may result in direct mortality from girdling and clipping of tree stems or reduced growth of surviving trees which have sub-lethal injuries. In terms of conservation and sustainability of temperate forests, this feeding damage may limit regeneration of appropriate tree species in certain forest ecosystems. In addition, this damage increases the cost to reforest these stands in time for Free Growing Status, decreases net productive forested area, and results in loss of Mean Annual Increment. Feeding damage appears to be associated with high populations of voles in early successional habitats that develop after clearcut harvesting. The problem is widespread throughout the southern and central interior of B.C.

The 2009-10 project was designed to (1) complete measurements of the distribution and seasonal fluctuation of vole populations in relation to grass-seeded and non-grass-seeded areas in forest plantations; (2) relate vole population data to grass habitat and other vegetation over a range of plantations and site characteristics, and develop a “fourth approximation” of a forecast model of when and where voles will be a problem; (3) assess vole population numbers in recently harvested (2007) sites south of Kicking Horse River to determine if population declines are in all ages of clearcuts, east of Golden; and (4) prepare a Wildlife Species Inventory final report: “Vole feeding damage and forest plantation protection in the Golden TSA: Susceptibility of new plantations”.

Project areas were located on 7 units at Glenogle Creek and Roth Creek, ca. 25 km east of Golden, and covered a range of harvesting ages, systems, and sites. Units were selected to provide a range of grass habitat conditions on landings, skid trails, and roadsides to assist in developing phase 3 of a forecast model of when and where vole populations will be a problem in plantations. Long-term monitoring units are 821-58 (grid C), 825-1 (grid D), 825-6 (grid E), and 821-2 (grid F). All sites were selected on the basis of operational scale, reasonable proximity to one another, and have been monitored since the time of harvesting (2004). Grass habitats on 821-44 and 818-1 were sampled in May and June 2009 to follow population fluctuations of voles.

Populations of long-tailed voles were low in the first two years after harvest with mean numbers < 5 to 15/ha. Annual peaks of 49-84 voles/ha were recorded in 2006. In the fourth year (2007) since harvesting, numbers of voles declined on two of three grids, deepened in 2008 and reached extirpation in 2009. On the extensive sites, vole numbers increased 4.6-5.3 times from 1-2 to 3-6 years post-harvest before declining thereafter. There were few significant relationships between abundance of voles and habitat characteristics. A multiple regression analysis of the six best independent variables (crown volume index of grasses, volume of downed wood, number of large pieces of downed wood, total species richness of vascular plants, structural diversity of herbs, and crown volume index of herbs) yielded a significant (r=0.67; P=0.04) result. There was a significant negative (r=-0.41; P=0.05) relationship between number of voles and crown volume index of shrubs and trees. Three independent analyses indicated that vole numbers were higher on those sites seeded with pasture grasses and forbs, whether they were along skid-trails, roadsides, or miscellaneous seedings. There was a significant positive (r=0.57; P=0.01) relationship of percentage tree mortality and abundance of voles (*Microtus*) across a relatively wide geographic area. There was considerable variation in our density-dependent vole damage relationship.

In terms of the forecast model, 3-4 years post-clearcut harvesting is a critical time for population buildups of voles and subsequent damage to plantation trees. Seeded grass species clearly create optimum habitat conditions for voles, generating population densities up to 30-50 voles/ha, which is in the range of a “high” damage risk to seedlings. Risk ratings for feeding damage to trees (voles/ha) were low (< 7), moderate (7-34), high (35-88), and very high (> 88).

3.0 Background

3.1 The Problem

The problem of feeding damage to forest and agricultural crops by herbivorous small mammals has a long history in temperate and boreal ecosystems of North America and Eurasia (Moore, 1940; Myllymäki, 1977; Byers, 1984; Getz, 1985; Conover, 2002). In forestry, voles of the genera *Microtus* and *Clethrionomys* are considered the major mammalian species affecting coniferous and deciduous tree plantations in North America (Sartz, 1970; Radvanyi, 1980; Bergeron and Jodoin, 1989; Sullivan et al., 1990), Europe (Hansson, 1985; 1991), and Asia (Shu, 1985; Sullivan et al., 1991). Populations of some species of voles tend to have cyclic fluctuations in abundance in northern latitudes with a peak every 3 to 5 years, although these periods may be interspersed with annual fluctuations in abundance (Krebs and Myers, 1974; Taitt and Krebs, 1985; Körpimaki and Krebs, 1996; Boonstra et al., 1998).

Voles of the genus *Microtus* are considered one of the major mammalian pests in coniferous tree plantations in the Golden TSA. The diet of voles consists primarily of grasses, sedges, and forbs. However, these rodents will feed on tree seedlings and saplings, particularly during winter months of peak years in abundance. Voles may feed on bark, vascular tissues, and sometimes roots of trees. This damage may result in direct mortality from girdling and clipping of tree stems or reduced growth of surviving trees which have sub-lethal injuries. Planted trees, with their nursery fertilization regime and enhanced palatability and nutrition, are nearly always preferred by voles over wildlings arising from natural regeneration (Sullivan and Martin 1991). In terms of conservation and sustainability of temperate forests, this feeding damage may limit regeneration of appropriate tree species in certain forest ecosystems. In addition, this damage increases the cost to reforest these stands in time for Free Growing Status, decreases net productive forested area, and results in loss of Mean Annual Increment. Feeding damage appears to be associated with high populations of voles in early successional habitats that develop after harvesting. The problem is widespread throughout the southern and central interior of B.C.

Three species of *Microtus*, the long-tailed vole (*M. longicaudus*), the meadow vole (*M. pennsylvanicus*), and the montane vole (*M. montanus*) are implicated as major consumers of tree seedlings. A fourth species, the heather vole (*Phenacomys intermedius*) is also present in these small mammal communities but exists at low abundance (< 5 animals/ha). In addition, populations of the southern red-backed vole (*Myodes gapperi*) occur primarily in mature stands of timber (Merritt 1981) but may spill over into recently cut areas for 1-2 years after harvest. It is likely that these voles already lived on the forested site prior to logging and continue there for a few years afterward, possibly feeding on lodgepole pine seed from cone slash. Red-backed voles disappear from harvested sites by 2 years post-logging, probably because their preferred food source, hypogeous fungi, are in short supply (Sullivan and Sullivan 2001; Klenner and Sullivan 2003, 2009).

Abundance of *Microtus* populations and degree of damage is usually highest in early successional habitats that develop after forest harvesting by clearcutting (Hansson, 1989; 1991; Sullivan and Sullivan, 2001; Sullivan et al., 2001), wildfires (Fisher and Wilkinson 2005), and in old fields (perennial grasslands) undergoing afforestation (Radvanyi, 1980; Bergeron and Jodoin, 1989; Ostfeld and Canham, 1993; Ostfeld et al., 1997). Grasses, herbs, and shrubs in these habitats provide food and cover for *Microtus* voles (Batzli, 1985; Ostfeld, 1985). The preference of *M. longicaudus* and *M. pennsylvanicus* for the early-successional habitats of clearcut and seed-tree origin may be explained by the abundance of herbs and grasses providing food and cover (Reich 1981; Getz 1985). The occurrence of *M. longicaudus* on clearcut and seed-tree sites, and to some degree on patch-cut sites, fits the variety of habitats occupied by this vole (Halvorson 1982; Van Horne 1982; Morris 1984; Smolen and Keller 1987). Habitats with some open areas and shrub and sapling cover at 7 to 10 years after clearcutting, appeared optimum for *M. longicaudus* in Alaska (Van Horne 1982). Later seral stages with less understory vegetation and thick canopies appear to have lower densities of long-tailed voles.

3.2 Monitoring of Vole Populations

Population fluctuations of *Microtus* are generally unknown in the Golden TSA, and it appears that vole populations may be high on some sites every year.

This monitoring component is a continuation of Forest Science Project (FSP) Y073138 which was initiated in 2004, and continued through to 2006, with four installations to follow population fluctuations of the four species of voles in the Glenogle and Roth Creek study areas east of Golden. Monitoring has been conducted from June to September 2004, and May to September 2005 and 2006, yielding 16 monthly datasets for analysis. We continued monitoring vole populations on these same sites in 2007-2009 (FSP Y103081) to record when populations start declining.

3.3 Grass and Non-grass Habitats

Grass seeding is currently used to prevent soil erosion, site degradation, and invasion of noxious plant species on newly harvested sites, but there is much disagreement as to the validity and necessity of this practice. The role of seeded pasture grasses providing potentially ideal habitat for buildups of vole populations needs to be addressed. Seeding of landings, road-sides, and skid-trails with these grass species for slope stabilization and erosion control may be an essential practice on some harvested sites. However, the subsequent spread of these grasses may alter the regenerating ecosystems in unfavourable ways. Typical pasture/forage seed mixtures include: introduced species of orchard grass (*Dactylis glomerata*), timothy (*Phleum pratense*), red fescue (*Festuca rubra*), crested wheatgrass (*Agropyron cristatum*), red top (*Agrostis alba*), alfalfa (*Medicago sylvatica*), and clover (*Trifolium pratense*).

A critical question is: What effects does grass seeding have on the plant community and vole populations occupying recently harvested units? There is a need to know the status of vole populations in many different vegetation complexes, including those with a high component of grasses, in order to identify those sites that are particularly susceptible to feeding damage. Do the seeded grass communities favour development of vole habitat and essentially predispose such sites to severe feeding damage to planted trees? Knowledge of the relationship of vole numbers to availability of grass-seeded habitat, in a given plantation, will also relate to factors such as planting density of trees, tree species selection, Free Growing Status, application of pest management methods, and other decision-making tools.

4.0 Objectives

This project was designed to:

(1) Complete measurements of the distribution and seasonal fluctuation of vole populations in relation to grass-seeded and non-grass-seeded areas in forest plantations;
(2) Relate vole population data to grass habitat and other vegetation over a range of plantations and site characteristics, and develop a “fourth approximation” of a forecast model of when and where voles will be a problem;
(3) Assess vole population numbers in recently harvested (2007) sites south of Kicking Horse River to determine if population declines are in all ages of clearcuts, east of Golden; and
(4) prepare a Wildlife Species Inventory final report: “Vole feeding damage and forest plantation protection in the Golden TSA: Susceptibility of new plantations”.

5.0 Study Areas and Design

5.1 Monitoring of Vole Populations

This project was located at Glenogle Creek and Roth Creek, 25 km east of Golden, in the Golden TSA. Long-term monitoring units are 821-58 (grid C), 825-1 (grid D), 825-6 (grid E), and 821-2 (grid F) (see Fig. 1). All sites were selected on the basis of operational scale, reasonable proximity to one another, and have been monitored since the time of harvesting (2004). All sites are far enough apart to be statistically independent.

5.2 Grass and Non-grass Habitats

This project was located on 15 units at Glenogle Creek and Roth Creek, and covered a range of harvesting ages, systems, and sites (Fig. 1; Table 1). Units were selected to provide a range of grass habitat conditions on landings, skid trails, and roadsides to assist in developing phase 4 of a forecast model of when and where vole populations will be a problem in plantations.

6.0 Methods

6.1 Long-term Monitoring of Vole Populations

Vole populations (and other forest floor small mammal species) were sampled at 4-week intervals from May to September 2007, 2008, and 2009 and previously in 2004-2006. Trapping grids (1 ha) had 49 (7 x 7) trap stations at 14.3-m intervals with one Longworth live-trap at each station. Traps were supplied with whole oats, and cotton as bedding. Traps were set on the afternoon of day 1, checked on the morning and afternoon of day 2 and morning of day 3, and then locked open between trapping periods. All small mammals (except shrews and weasels) captured were ear-tagged and immediately released at the point of capture (Krebs et al., 1969). Forest floor small mammal species sampled by this procedure included the long-tailed vole, as well as the meadow vole, heather vole, southern red-backed vole, deer mouse (*Peromyscus maniculatus*), northwestern chipmunk (*Tamias amoenus*), montane shrew (*Sorex monticolus*), common shrew (*S. cinereus*), and short-tailed weasel. Abundance estimates of long-tailed voles, total *Microtus*, and total small mammals were derived from the Jolly-Seber (J-S) stochastic model (Seber 1982).

Inventory Methods for Small Mammals: Shrews, Voles, Mice & Rats (Version 2.0)

3.7.1 Recommended Method: Mark Recapture
3.7.2 Objectives of Surveys
3.7.3 Open vs. closed populations
3.7.4 Models of estimation and methods of analysis
3.7.5 Recommended Models
3.7.6 Office Procedures
3.7.7 Sampling Design
3.7.8 Sampling Effort
3.7.9 Equipment
3.7.10 Field Procedures
Data will be housed with NRIN in the format of Inventory Methods for Small Mammals (Version 2.0).

6.2 Index-line Surveys in Grass and Non-grass Habitats

One index-line was installed in each grass and non-grass habitat (Table 1) within a given unit and allowed to pre-bait for 4 weeks prior to the actual survey of voles. An overall total of 15 units were sampled with index-line surveys in 2007, 2008, and 2009. Traps were supplied with whole oats and cotton and locked open for the pre-bait period. For the survey, index-line traps were set on the afternoon of day 1, checked on the morning and afternoon of day 2 and morning of day 3, and then picked up and moved to the next unit for a pre-bait period. Animals captured were processed in an identical manner to the grid sampling procedure.

6.3 Grid and index-line sampling in grass and non-grass habitats

Three units were selected that had grass-seeded (818-103G, 818-103H, 818-103I) habitats and three units that had little or no grass (818-5, 825-1, 821-2). A 1-ha live-trapping grid was installed in each site and long-tailed voles were sampled over 8 trapping periods from May to September 2005 and May to June 2006. Additional grass and non-grass habitats were sampled by permanent index-lines from May to September 2008 to May to June 2009 (7 trapping periods). Methods of capture and processing of animals were identical to those described for the long-term sampling of voles (section 6.1).

6.4 Vegetation Sampling

At 5 of the 7 trap stations along each index-line, a 3-m x 3-m plot for sampling shrubs and a 1-m x 1-m plot for sampling herbs was installed (after Stickney 1985). Herb and shrub layers were subdivided into height classes: 0-0.25, 0.25-0.50, 0.50-1.0, 1.0-2.0, 2.0-3.0, and 3.0-5.0 m. A visual estimate of percentage ground cover was made for each species/height class combination within the appropriate nested subplot. These data were then used to calculate crown volume index (m^3/0.01 ha) for each species. The product of percent cover and representative height gave the volume of a cylindroid which represented the space occupied by the plant in the community. Crown volume index values were then averaged by species for each plot size, and converted to 0.01-ha base to produce the values given for each species and layer (herbs, shrubs, and trees). Total percentage cover for each layer was also estimated for each plot. Sampling was done in July-August 2007 and 2008.

6.5 Grass-Vole-Tree Damage Relationship

A risk rating for feeding damage to trees, based on an index-line survey of voles in a given unit, was derived from the significant ($F_{1,17}$=8.86; P<0.01) positive relationship of percentage tree mortality and abundance of voles (*Microtus*). These data were derived from several study areas in B.C., including Golden project areas, where the number of voles per ha was known in October of a given year. Newly planted tree seedlings (primarily Douglas-fir, lodgepole pine, and some interior spruce) were available on the same sites where vole abundance had been measured and overwinter damage to trees (percentage mortality) by voles was then related to the October population estimate.

6.6 Statistical Analysis

A one-way ANOVA was used to determine the effect of time (years) since clearcut harvesting and Biogeoclimatic subzone on vole numbers in plantations. A linear regression analysis was used to determine the relationship of vole numbers on index-lines to numbers on a grid system, as well as the relationship of tree seedling mortality to number of voles. This regression analysis was also used to relate vole numbers in plantations to abundance of herbs, grasses, shrubs, and trees, species richness and diversity, and structural diversity of total vascular plants, volume of down wood, and other site characteristics. A step-wise multiple regression analysis was conducted on the six most meaningful relationships of the influence of site characteristics on vole abundance in plantations. Proportional data were arcsine-transformed prior to analysis. Means and 95% confidence intervals were calculated for the number of voles in each year on the long-term sampling grids. A paired sample *t*-test was used to compare the number of long-tailed voles captured by index-lines in the 15 surveyed plantation units, and the grid-based and index-line monthly samples of voles in grass and non-grass sites. Duncan's Multiple Range Test (DMRT) was used to evaluate mean values after statistically significant ANOVAs. In all analyses, the level of significance was at least P = 0.05.

7.0 Results

7.1 Long-term Monitoring of Vole Populations

Vole populations have been monitored on sampling grids for six years (2004-2009), since the time of harvesting, to follow how these rodents respond to successional change and reach densities capable of serious feeding damage to newly planted trees. Over 29 trapping periods, the long-tailed vole was the most abundant microtine with a total of 625 individuals captured (96.7% of total *Microtus*), followed by 21 meadow voles, 113 red-backed voles, and 104 heather voles. Susceptibility to capture was measured by Jolly trappability estimates with a mean value of 68.5% (range 66.9-70.2%) for long-tailed voles. Populations of long-tailed voles were low in the first year after harvest with mean numbers < 5/ha (Figs. 2 and 3). Mean numbers in the second post-harvest year reached 15/ha and had a strong annual cycle with up to 43 animals/ha. Annual peaks of 49-84 voles/ha were recorded in 2006, which seemed to be the peak populations on the three grids (Fig. 2). However, in the fourth year (2007) since harvesting, numbers of long-tailed voles declined, particularly on grids D and F, but grid E remained high reaching an annual peak of 82/ha. This decline deepened in 2008 and reached extirpation on two of three grids in 2009. For red-backed voles, in the first year after harvesting, mean numbers ranged from 3.5-

14.8/ha. However, their numbers declined dramatically at two years after harvesting. The heather vole occurred at numbers ≤ 6/ha throughout 2004-2008 and then declined to < 1/ha in 2009.

7.2 Index-lines and Vole Populations

The long-tailed vole was the most abundant microtine with a total of 340 individuals captured (93.2% of total *Microtus*), followed by 25 meadow voles, 17 red-backed voles, and 15 heather voles on the 57 (27 habitat characteristics plus 15 grass and 15 non-grass) index-lines. Petersen population estimates, with 95% C.I., for long-tailed voles for the index-line in each of the 27 sites surveyed are listed in Table 2. The conversion (y=0.1844x+3.6814) of index-line numbers to per ha was based on the positive linear relationship (r=0.69; P=0.02) (Fig. 4). The converted population estimate for long-tailed voles, from each index-line, was designed to control for the effect of seasonal change in vole abundance. These vole abundance estimates were used in all subsequent analyses of habitat characteristics in the 27 sites.

7.3 Voles and Habitat Characteristics

The relationship of vole numbers to BEC subzone, over years 3 to 6 post-harvest, indicated that there was a significant ($F_{2,14}$=4.40; P=0.03) difference among the three subzones during this period. The IDF_{dm} had a mean (± S.E.) number of 190.8 ± 67.8 voles/ha, with the MS_{dk} at 63.5±7.7 and the ICH_{mk} at 107.0±36.7 voles/ha. The IDF_{dm} and ICH_{mk} numbers were similar as were the MS_{dk} and ICH_{mk}, with the IDF_{dm} and MS_{dk} numbers being significantly (DMRT; P=0.05) different. The relationship of mean vole abundance per ha to time since clearcut harvesting ranged from low (17.3 voles) numbers at 1-2 years, and then up to 79.0 and 91.2 voles at 3-4 and 5-6 years, respectively, post-harvest (Fig. 5). Vole abundance then declined to 23.9 animals/ha at 9-10 years post-harvest. There was no statistical difference ($F_{4, 25}$=0.86; P=0.50) in vole abundance among these time periods. However, numbers did increase 4.6-5.3 times from 1-2 to 3-6 years before declining thereafter (Fig. 5).

There were few significant relationships between abundance of voles and any one of the habitat characteristics. Four weak positive relationships were between voles and crown volume index of grasses (r=0.33; P=0.09), volume of downed wood (r=0.32; P=0.11), and total species richness of all vascular plants (r=0.38; P=0.05) (Fig. 6A-C). Number of large (≥ 20 cm diameter) pieces of downed wood (r=0.53; P<0.01) and the relationship of vole numbers to area (r=0.46; P=0.08) also followed this pattern. There was a significant negative (r=-0.41; P=0.05) relationship between number of voles and crown volume index of shrubs and trees (Fig. 6D). There were no other meaningful relationships between habitat characteristics (amounts and diversity of vegetation components) and numbers of voles: including crown volume index of individual species of herbs, shrubs, and trees. A multiple regression analysis of the four best-fit independent variables plus two components of the herb layer: structural diversity of herbs (r=0.23; P=0.25), and crown volume index of herbs (r=0.15; P=0.44), did yield an overall significant (r=0.67; P=0.04) result.

7.4 Grass and Non-grass Habitats

There was a significant (r=0.46; P=0.01) positive relationship between numbers of long-tailed voles and percentage cover of grasses in the index-line survey (n=15) of plantation units (Fig. 7). Mean (±S.E.) cover of grasses was 61.7±4.6% in the grass habitats and 1.8±1.0% in the non-grass habitats. This pattern was also observed for percentage cover of total herbs, but the trend only approached significance (r=0.33; P=0.07) (Fig. 7). Mean cover of herbs was 70.0±3.0% in the grass habitats and 26.4±3.0% in the non-grass habitats. The number of long-tailed voles captured by index-lines in the 15 surveyed plantation units was significantly (t_{14}=4.05; P<0.01) higher in the grass than non-grass habitats. A threshold level of 50% grass cover was required to generate suitable habitat for vole numbers to reach tree damage levels.

On grid systems, mean numbers of long-tailed voles were significantly (t_7=4.04; P<0.01) higher (1.5 to 2.6 times) in the grass (mean=23.5±4.6) than non-grass (mean=12.8±2.2) habitats during 2005 and early 2006 (Fig. 8). Mean (±S.E.) cover of grasses was 20.0±1.8% in the grass habitats and

0.9±0.9% in the non-grass habitats in this grid-based analysis. Mean cover of herbs was 34.2±11.4% in the grass habitats and 26.5±9.3% in the non-grass habitats.

Similarly, on index-lines, mean numbers of long-tailed voles also followed this pattern of significance (t_6=4.27; P<0.01), being 1.4 to 3.7 times higher in the grass (mean=6.4±1.7) than non-grass (mean=3.3±1.2) during 2008 and early 2009 (Fig. 9). Mean cover of grasses was 80.7±6.9% in the grass habitats and 1.1±0.6% in the non-grass habitats. Mean cover of herbs was 83.3±4.9% in the grass habitats and 21.2±5.4% in the non-grass habitats. Thus, in both these cases, mean abundance of voles was maintained at a higher level in the grass than non-grass habitats through the summer, fall, and subsequent spring seasons.

Thus, three independent analyses showed clearly that vole numbers were higher on those units with grass-seeded sites, whether they were along skid-trails, roadsides, or miscellaneous seedings.

7.5 Vole abundance and Tree mortality

Most cutover forest sites in the interior of B.C. are planted with tree seedlings at a density of 1400-1600 per ha. The incidence of mortality of trees from feeding damage by voles in our general Golden study area has ranged from 15% to 100%. Sites have been re-planted (in some situations several times) whenever tree loss is unacceptably high (e.g., < 700 surviving trees/ha). Presumably the incidence of damage is related to the abundance of voles. There was a significant positive (r=0.57; P=0.01) relationship of percentage tree mortality and abundance of voles (*Microtus*) (Fig. 10). Thus, the number of voles on a given site can be related to the potential for feeding damage to trees in that particular plantation. It is important to note that in some cases there can be relatively high numbers of voles (in the moderate category), but little damage to tree seedlings. Conversely, a relatively low number of voles may, in certain situations, damage a high percentage of trees. Based on this relationship, a risk rating for damage to trees would be, in terms of number voles/ ha: Low < 7; moderate 7-34; high 34-88; very high > 88 (Fig. 10).

8.0 Discussion

8.1 Voles and Tree Damage

The positive relationship of the incidence of overwinter damage to trees and vole abundance in the previous autumn, in three geographic areas of B.C., is the first such analysis for forest plantations, on harvested sites, in North America. Ostfeld and Canham (1993) and Ostfeld et al. (1997) reported a similar relationship between meadow vole density and seedling predation in old fields. Hanssen (1986) related vole abundance to degree of vole de-barking of trees at a small local scale in Sweden. Huitu et al. (2009) provided a density-dependent vole damage analysis, based on survey questionnaires, at a nationwide scale in Finland. These results strongly support population monitoring of voles as an effective means to forecast future outbreaks in damage to new plantations.

There was considerable variation in our density-dependent vole damage relationship, as was also reported for the Finnish study (Huitu et al. 2009). In some cases, there was high (> 80% mortality) incidence of damage, but few voles (< 15/ha) recorded in that planting. Alternatively, there were few trees eaten (< 10%) at a very high (> 70/ha) abundance of voles in another experimental plantation (see Fig. 10). However, the prediction of H3 that damage incidence and vole abundance would be positively related seemed to be supported. Our regression relationships were based on vole numbers and various habitat characteristics. The implicit understanding was that vole numbers and incidence of tree damage were highly correlated, which was supported by a reasonably strong relationship. The Golden study area had a history of vole damage and all sites had been replanted, some a multitude of times, and hence it was not possible to use incidence of tree damage as a dependent variable. Most plantations had several cohorts of trees from successive planting events. Newly planted seedlings are primarily damaged in the first winter when the fertilization regime renders them particularly palatable to voles (Sullivan and Martin 1991, Sullivan and Sullivan 2008). This immediacy of vole predation on seedlings was also recorded in old fields by Ostfeld and Canham (1993). Damage may still occur in subsequent winters, but tends to be

minor by 2-3 years post-planting. This pattern is likely related to vole populations starting to decline by 4-5 years after harvest. Feeding damage to trees in older plantations tends to be in "hotspots" where a few long-tailed voles reside.

There was considerable variation in the relationship of vole abundance (and hence tree damage) to habitat characteristics. The multiple regression of six factors explained 45% of this variation, but other site specific factors such as moisture (may be related to aspect), proximity to source populations of long-tailed voles, and incidence of predators could also be important. Most *Microtus* species respond favorably to moisture-bearing sites with enhanced herbaceous growth (Getz 1985). Long-tailed voles were captured mainly on seepage sites in north-aspect burned units in Montana (Halvorson 1982). Similar results were recorded for creeping voles (*M. oregoni*) in Oregon (Gashwiler 1970, Hooven 1973).

Source populations of long-tailed voles pose an interesting scenario. This microtine was recorded at low abundance (< 10/ha) in closed canopy forests (Van Horne 1982, Klenner and Sullivan 2003). Thus, it seemed unlikely that older uncut forests were source areas, rather openings and natural meadows supplied sufficient early successional forbs and grasses (Smolen and Keller 1987). Contiguous units of clearcut harvesting over relatively short periods provided several hundred hectares of early successional habitat for long-tailed voles at the Golden study area. This rapid sequence of harvesting was typical of salvage operations for MPB-susceptible lodgepole pine dominated stands and has occurred in many parts of the PNW over the last decade. Thus, long-tailed voles presumably move from harvested site to site as new grass and forb communities develop. They may be assisted in this migration by road corridors with banks and edges seeded with pasture grasses. This practice occurs in many new road and cutblock installations in B.C. and perhaps other parts of the PNW as well. It has been discontinued in some nature reserves and National Parks because of the migration of alien flora (Tyser and Worley 1992). Although we do not have any data on vole movements, it seemed likely that long-tailed voles would disperse along these linear, potentially optimum, habitats since these microtines were so abundant in the grass index-lines. Moving to optimum habitats that maximize their fitness has been reported for other vole species (Lin and Batzli 2004).

8.2 Conclusions

A conceptual forecast model and evaluation of grass habitats and other site characteristics for predicting vole damage to plantations is summarized in Table 3. Time since clearcut harvesting at 3-4 years is a critical time for population buildups of voles and subsequent damage to plantation trees. Comparison of vole responses to clearcutting and variable retention systems may help clarify the role of harvesting method, where this is a flexible operational scenario. Larger patch sizes (area of clearcut site) tend to have a higher abundance of voles. Large contiguous openings, typical of MPB salvage harvesting, provide substantial habitat. Clearcut sites in the IDF_{dm} and ICH_{mk} subzones appeared to be most susceptible to vole abundance and consequent damage, although it must be noted that the IDF_{dm} sites also had a high degree of area seeded with pasture grasses. Seeded grass species clearly create optimum habitat conditions for voles, generating population densities up to 30-50 voles/ha, which is in the range of a "high" damage risk to seedlings. Risk ratings for feeding damage to trees (voles/ha) were low (< 7), moderate (7-34), high (35-88), and very high (> 88). However, there was considerable variability among plantation sites, incidence of damage, and abundance of voles.

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Table 1. Characteristics of all project sites in 2007-2009: 1) population monitoring and 2) survey units for index-line monitoring of vole populations in grass and non-grass habitats. [1] Number of growing seasons up to and including 2008.

Unit	Area (ha)	Year of harvest	Silv System	BEC	Age of site[1]	Initial planting	Age of plantation[1]
Population monitoring							
821-58	15.0	2003	CC	MS_{dk}	6	2003	6
825-1	22.3	2004	CC	MS_{dk}	5	2005	4
825-6	10.4	2004	CC	MS_{dk}	5	2004	5
821-2	21.1	2003-04	CC	ICH_{mk}	5	2005	4
Survey units							
806-4	25.3	1997-98	CC	ICH_{mk}	11	1999	10
812-1	33.5	1998-99	CC	MS_{dk}	10	1999	10
814-4	3.0	1999	CC	MS_{dk}	9	2000	9
818-4	16.4	2001	CC	ICH_{mk}	8	2002	7
818-5	5.6	2001	CC	MS_{dk}	8	2002	7
818-103G	20.0+	2003	CC	MS_{dk}	5	2004	5
818-103H	20.0+	2003	CC	MS_{dk}	5	2004	5
818-103I	9.2	2003	CC	IDF_{dm}	5	2004	5
821-42	2.6	2003	CC	MS_{dk}	5	2003	6
821-44	26.8	2004	CC	ICH_{mk}	4	2005	4
821-46	45.0	2004	CC	ICH_{mk}	4	2005	5
821-47	9.2	2004	CC	ICH_{mk}	4	2005	5
821-48	24.9	2004	CC	ICH_{mk}	4	2005	4
821-58	15.0	2003	CC	MS_{dk}	4	2003	4
825-6	10.4	2004	CC	MS_{dk}	5	2004	5

Table 2. Peterson population estimates of *M. longicaudus* on index-lines and per ha for the 27 sites sampled in 2006, and the three sites sampled in 2009. Confidence intervals (95%) are given in parentheses where sample size was appropriate. Number of growing seasons up to and including 2006[1] and 2009[2].

Site	Site characteristics		*M. longicaudus*		Converted estimate per ha	Month of trapping
	BEC	Age of site[1]	Index-line	Per ha		
138-1	$ESSF_{dk}$	14	6.5 (4.8-12.1)	15.3	15.3	Sept
806-3	MS_{dk}	10	3.0	3.0	3.0	Oct
806-4	ICH_{mk}	9	9.3 (7.9-12.5)	30.5	53.4	Aug
812-1	MS_{dk}	8	19.9 (17.7-24.9)	88.0	154.0	Aug
814-2	$ESSF_{dk}$	7	6.5	15.3	26.8	Aug
814-3	MS_{dk}	7	20.3 (11.0-99.3)	90.1	90.1	Oct
814-4	MS_{dk}	7	8.0 (5.8-17.6)	23.4	23.4	Oct

Site	Site characteristics		*M. longicaudus*		Converted estimate per ha	Month of trapping
	BEC	Age of site[1]	Index-line	Per ha		
814-5	MS_{dk}	7	0	0	0	Oct
818-101A	IDF_{dm}	5	8.0 (5.8-17.6)	23.4	64.8	July
818-101B	IDF_{dm}	5	17.7 (9.6-78.6)	76.0	210.5	July
818-102A	MS_{dk}	4	2.0	2.0	5.5	June
818-102B	MS_{dk}	4	7.0 (3.8-63.8)	18.0	67.5	June
818-103A	MS_{dk}	3	10.3 (8.2-27.7)	35.9	99.4	July
818-103B	MS_{dk}	3	9.5 (6.5-21.2)	31.6	87.5	July
818-1	IDF_{dm}	3	35.0 (21.8-96.4)	169.8	297.2	Aug
818-4	ICH_{mk}	6	11.0 (6.6-42.6)	39.7	69.5	Aug
818-5	MS_{dk}	6	5.0	7.2	19.9	July
821-42	MS_{dk}	4	2.0	2.0	5.5	July
821-44	ICH_{mk}	4	15.5	64.1	64.1	Sept
821-46A	ICH_{mk}	2	3.0	3.0	11.25	June
821-46B	ICH_{mk}	2	0	0	0	June
821-47	ICH_{mk}	2	11.6 (9.5-15.8)	42.9	42.9	Sept
821-48	ICH_{mk}	2	8.0 (7.1-9.1)	23.4	23.4	Sept
821-58	MS_{dk}	4	7.0	18.0	18.0	Oct
825-1	MS_{dk}	3	13.0 (8.7-35.4)	50.5	50.5	Sept
825-2	MS_{dk}	3	7.0	18.0	18.0	Oct
825-6	MS_{dk}	3	17.0	72.2	72.2	Oct
		Age of site[2]				
C-01A	ICH_{mk}	3	83.0 (25.6-158.8)	430.1	752.8	Aug
C-01B	ICH_{mk}	3	17.9 (13.5-29.8)	77.1	134.9	Aug
C-01C	ICH_{mk}	3	10.2 (7.8-19.9)	35.4	61.9	Aug
C-01A	ICH_{mk}	3	17.8 (14.6-25.7)	76.6	76.6	Sept
C-01B	ICH_{mk}	3	18.3 (11.0-47.3)	79.3	79.3	Sept
C-01C	ICH_{mk}	3	22.8 (18.8-33.5)	103.7	103.7	Sept

Table 3. List of factors contributing to vole population outbreaks and feeding damage to plantations in south-central British Columbia, Canada. Increase ↑ Decrease ↓

↑ <u>Clearcut harvesting</u> *3-4 years post-harvest*: period of high vole numbers and damage to seedlings *> 5-6 years post-harvest*: minor "hot spots" of damage in older plantations	<u>Herbaceous vegetation</u> Total species richness ↑ Native grasses Crown volume index of herbs Structural diversity of herbs
↑ <u>Large contiguous openings</u> MPB salvage units	<u>Shrubs and trees</u> ↓
	<u>Downed wood</u> Volume ↑ Number of large pieces
↑ <u>Seeding of pasture grasses</u> Ideal habitat for voles if >50% cover of grasses Use shrub species as alternative	
	Lodgepole pine cones : Seeds as a food source ↑

Figure 1. Map of projects units for survey of vole populations and grass habitats at Glenogle Creek and Roth Creek, 25 km east of Golden in the Golden TSA.

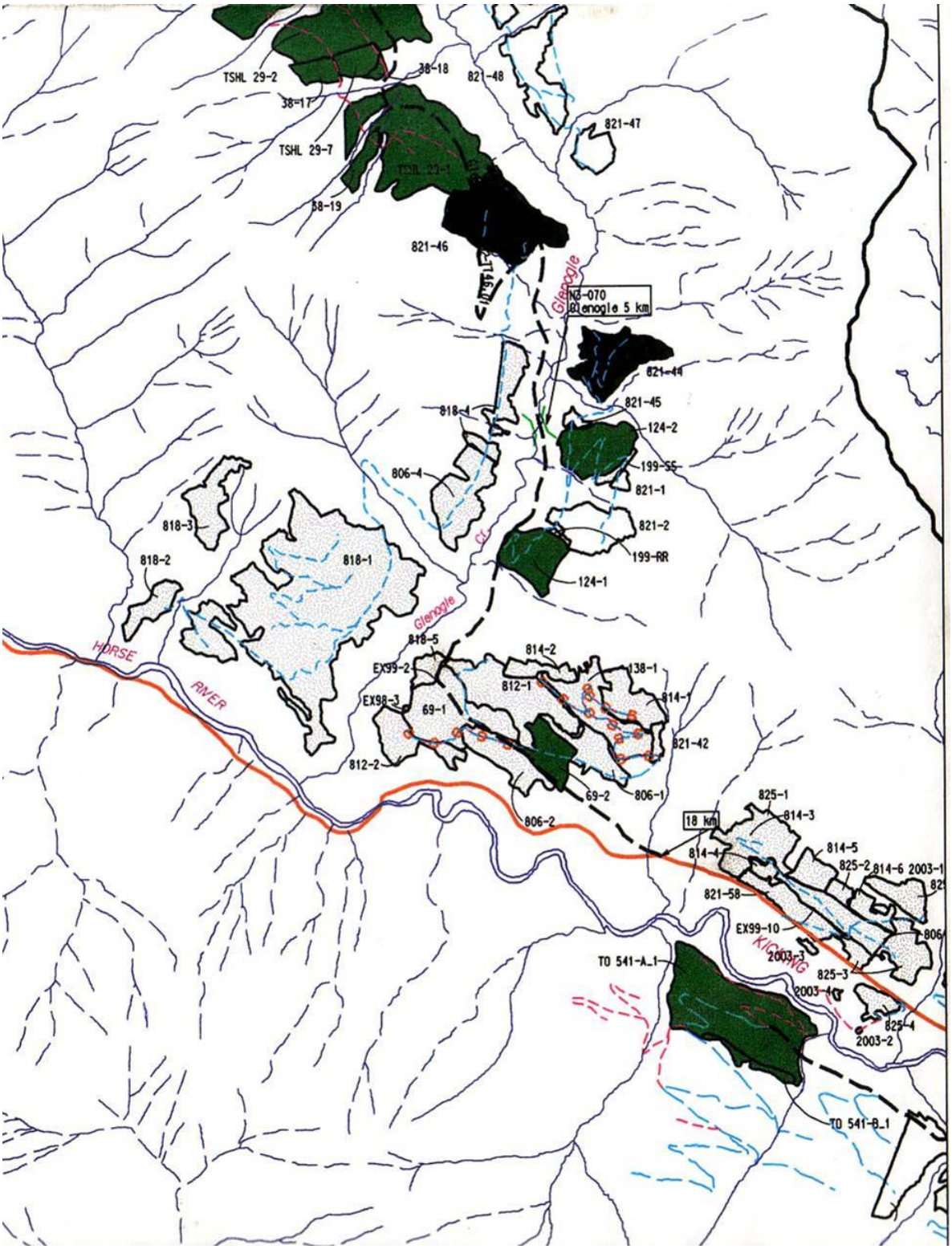


Figure 2. Abundance of long-tailed voles per hectare on three replicate sampling grids from the time of harvest, 2004-2009.

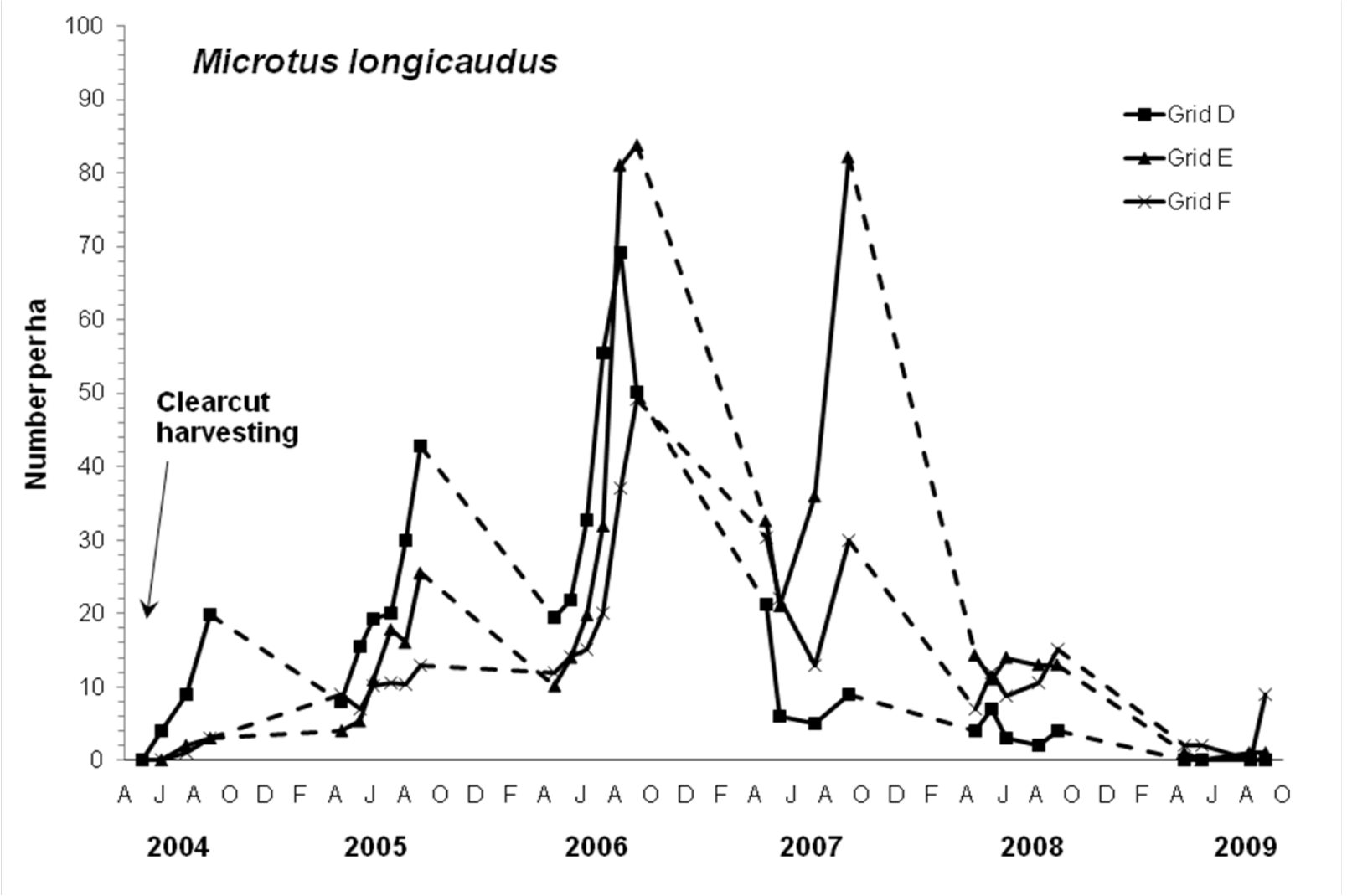


Figure 3. Mean (± 95% C.I.) abundance of long-tailed voles per hectare in each year of the study. Sample size (number of grid trapping periods) is above upper bar.

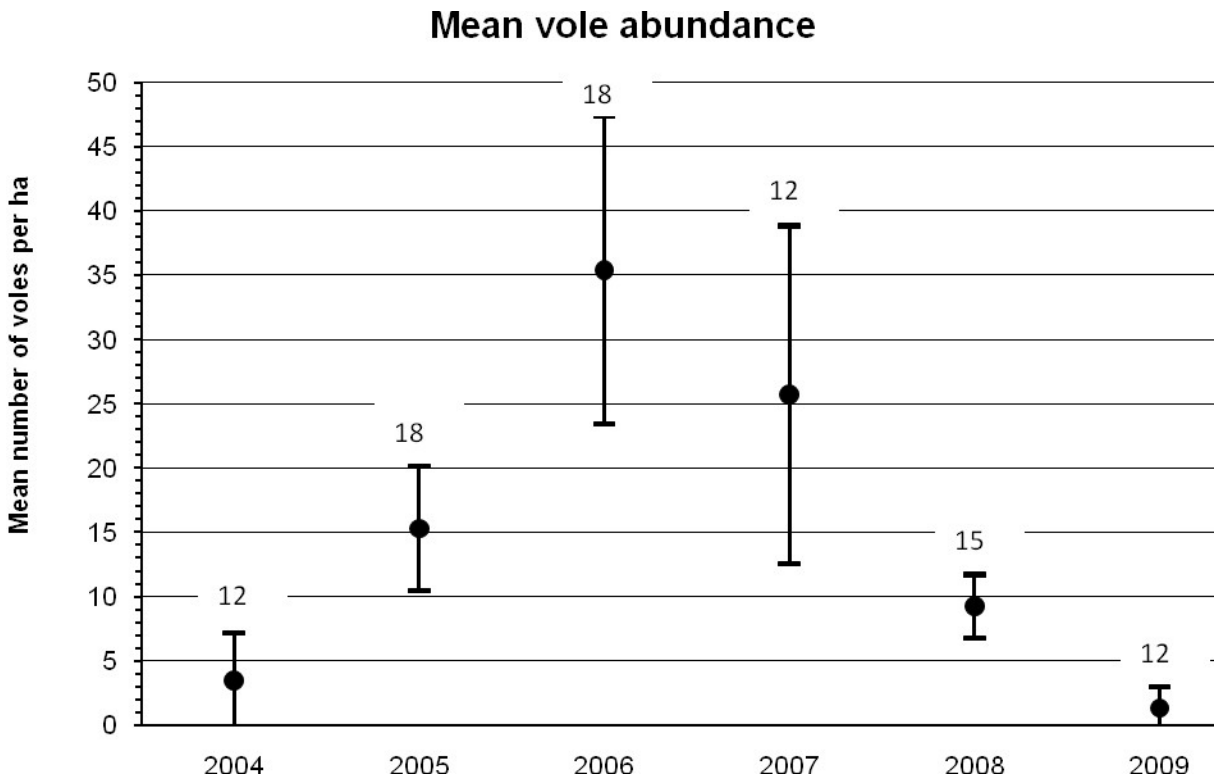


Figure 4. Linear regression analysis relating number of total voles on index lines to number on grids per ha.

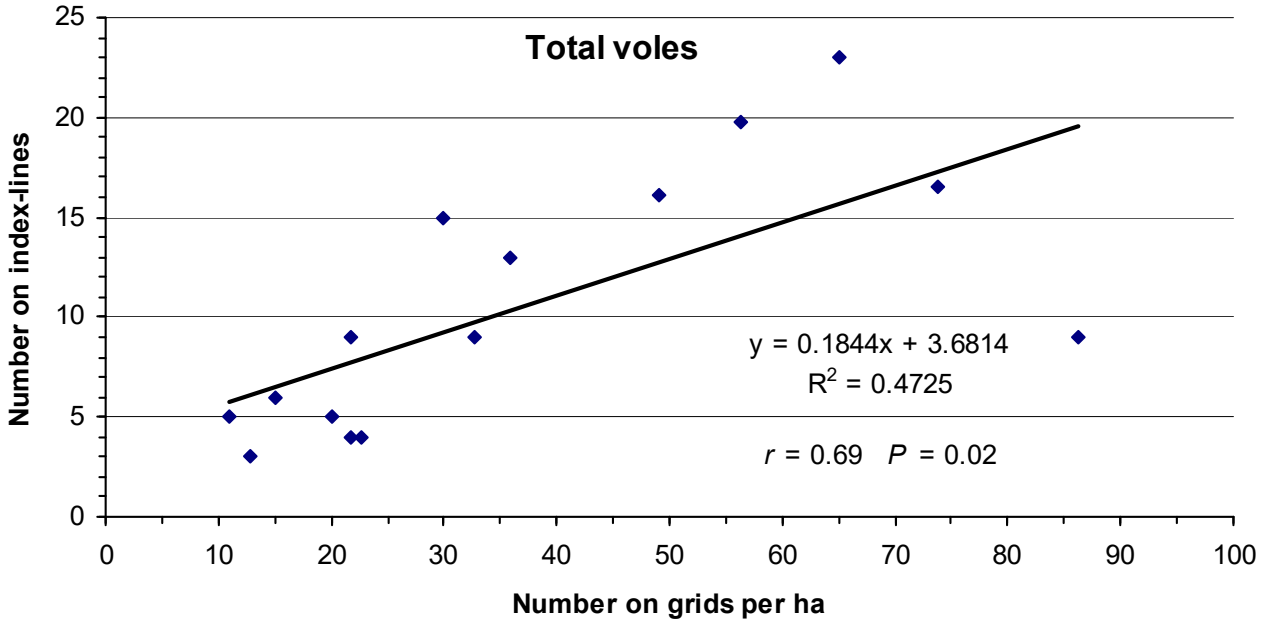


Figure 5. Mean (± 1 SE) number of long-tailed voles per ha at 1-2, 3-4, 5-6, 7-8, and ≥ 9 years since clearcut harvesting, as per the 2006 survey. Sample size given above each upper bar.

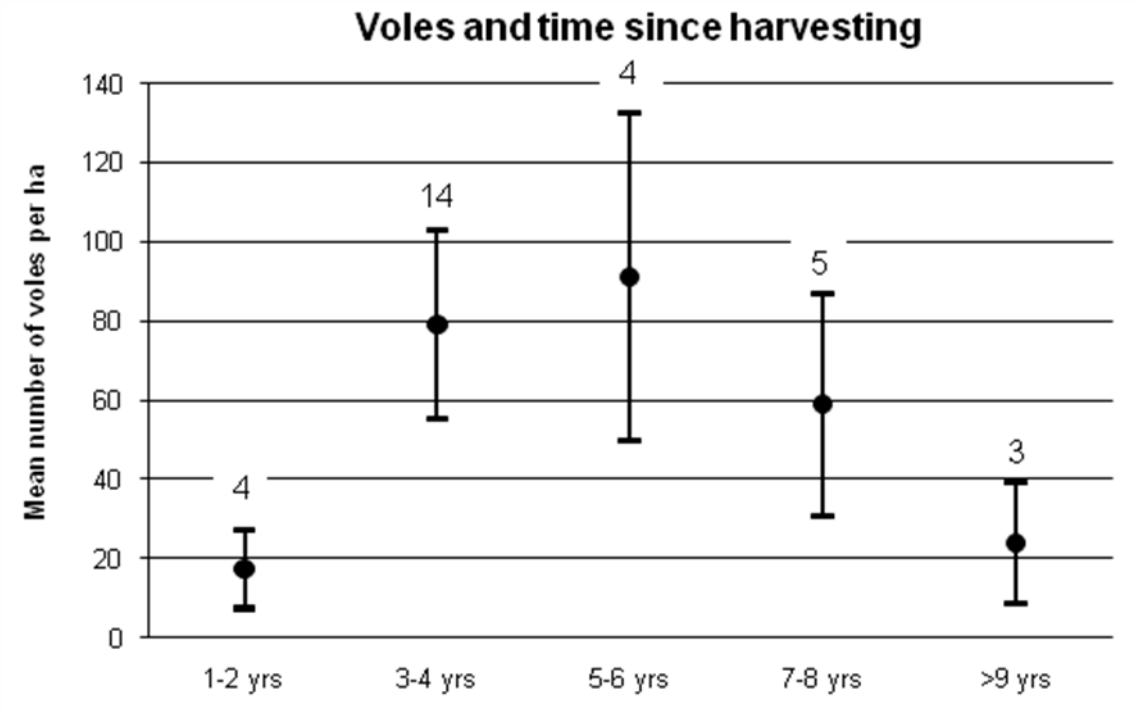
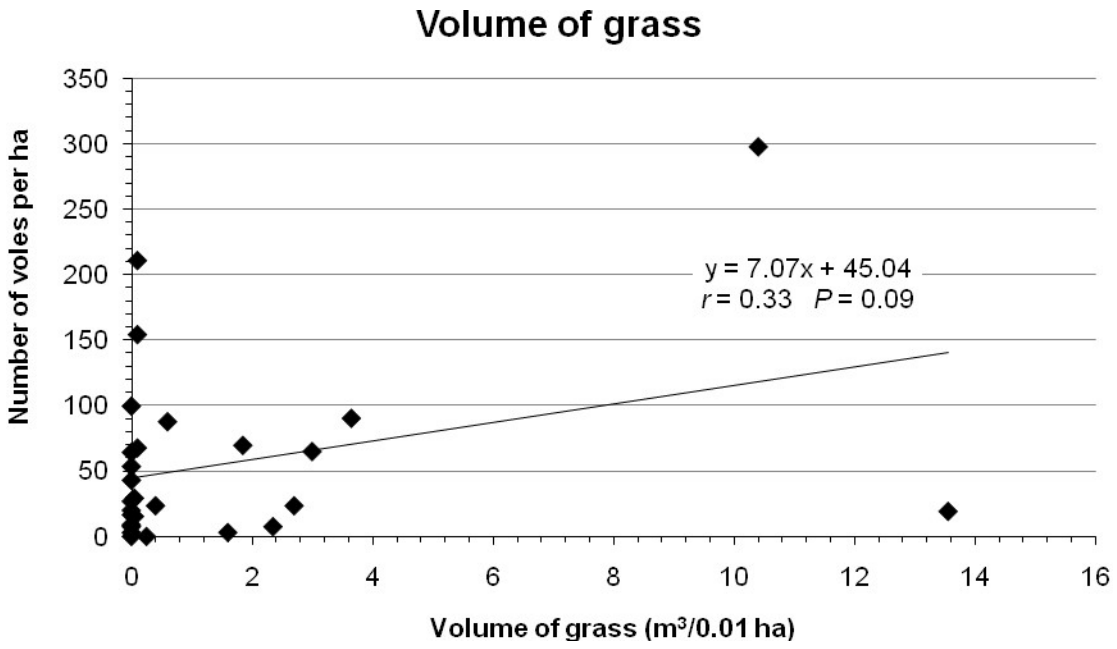
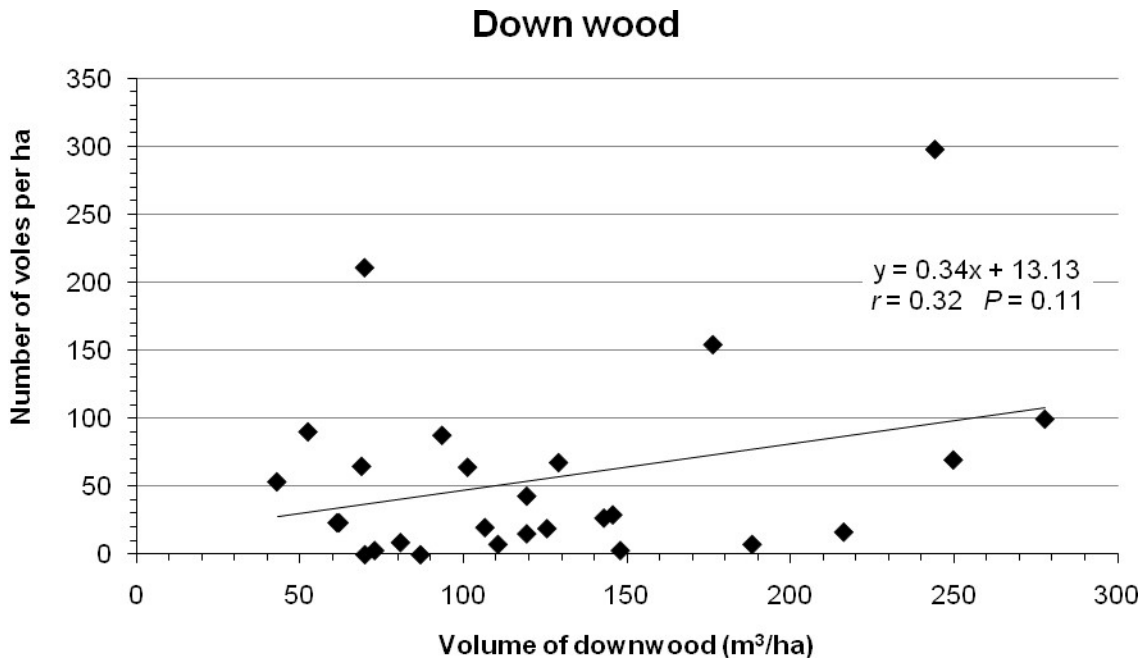


Figure 6. Relationship of the mean number of long-tailed voles per ha to (A) crown volume index of grasses (m^3/0.01 ha), (B) volume of down wood (m^3/ha), (C) total species richness of vascular plants, and (D) crown volume index of shrubs and trees (m^3/0.01 ha).

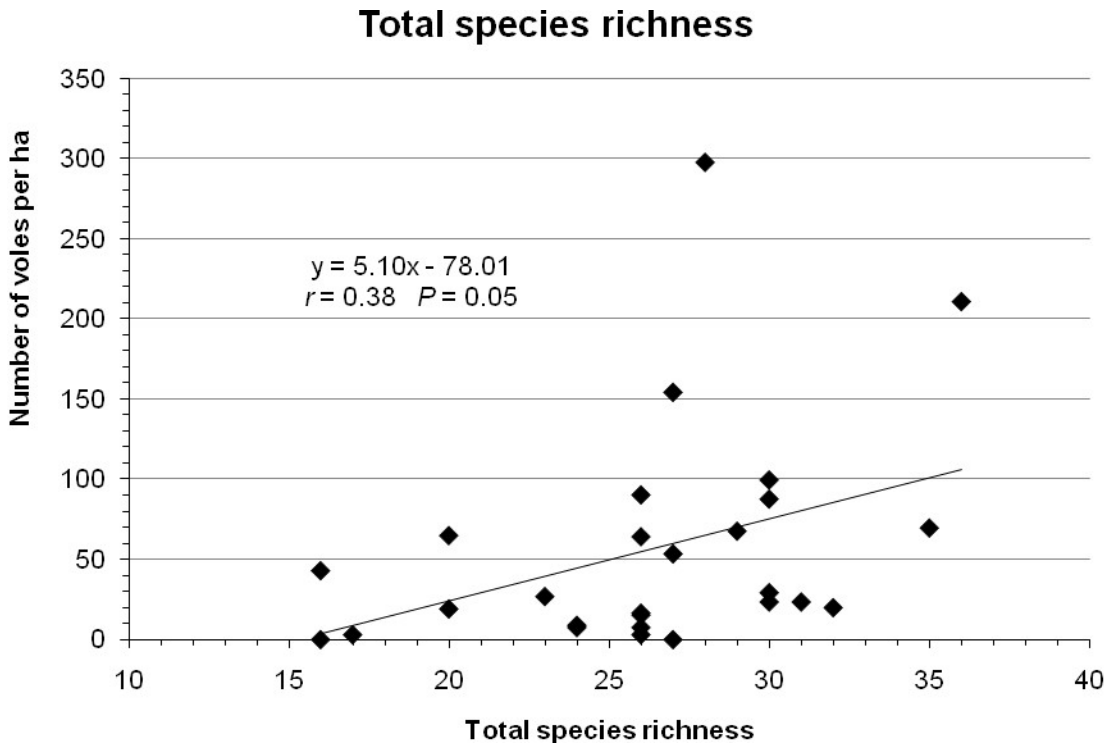
(A)



(B)


Down wood
Number of voles per ha
Volume of downwood (m3/ha)
y = 0.34x + 13.13
r = 0.32 P = 0.11
0
50
100
150
200
250
300
350

(C)


Total species richness
Number of voles per ha
Total species richness
y = 5.10x - 78.01
r = 0.38 P = 0.05
0
50
100
150
200
250
300
350
10
15
20
25
30
35
40

(D)

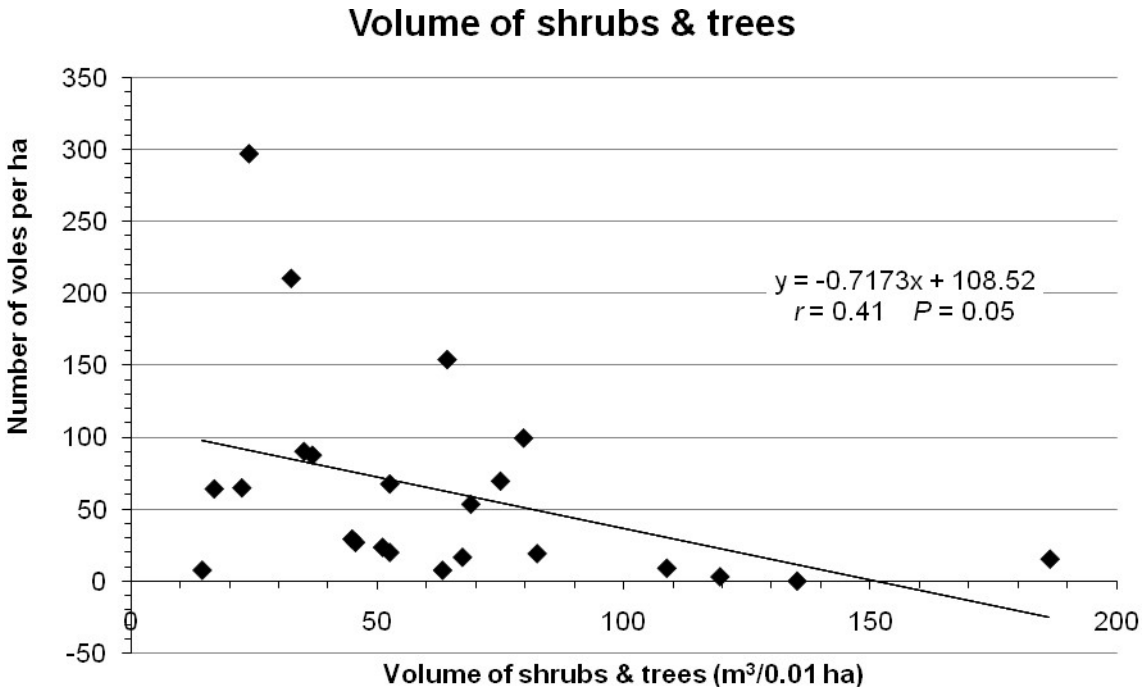
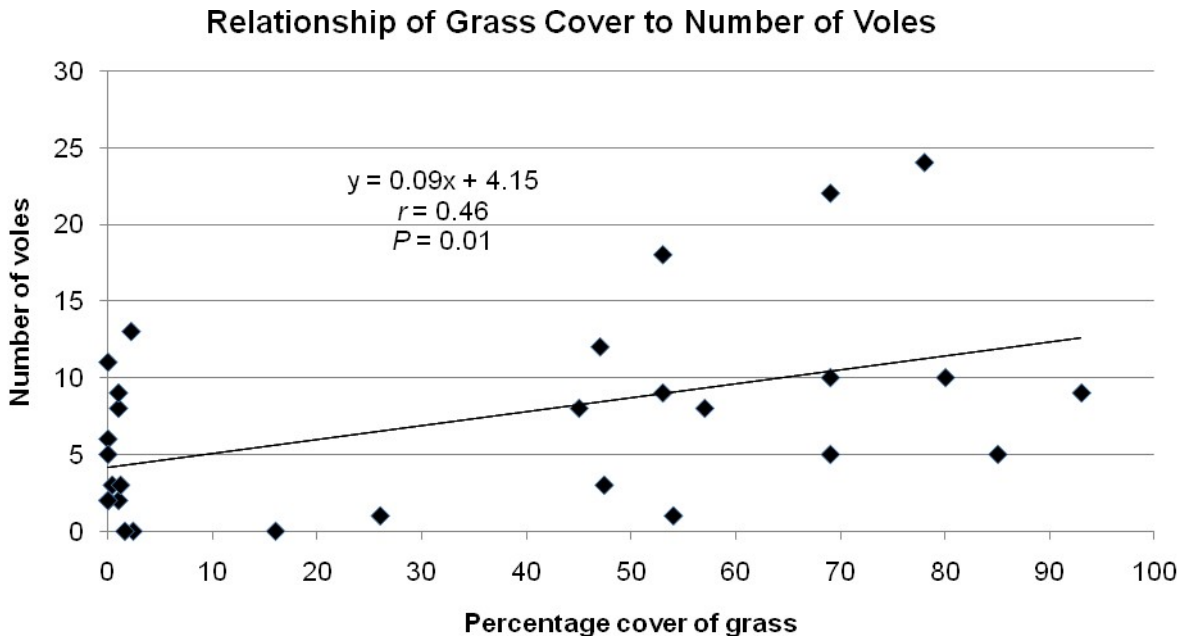


Figure 7. Linear regressions of the relationship of (A) cover of seeded pasture grasses and (B) herb cover to number of long-tailed voles in sampled plantation sites.

(A)



(B)

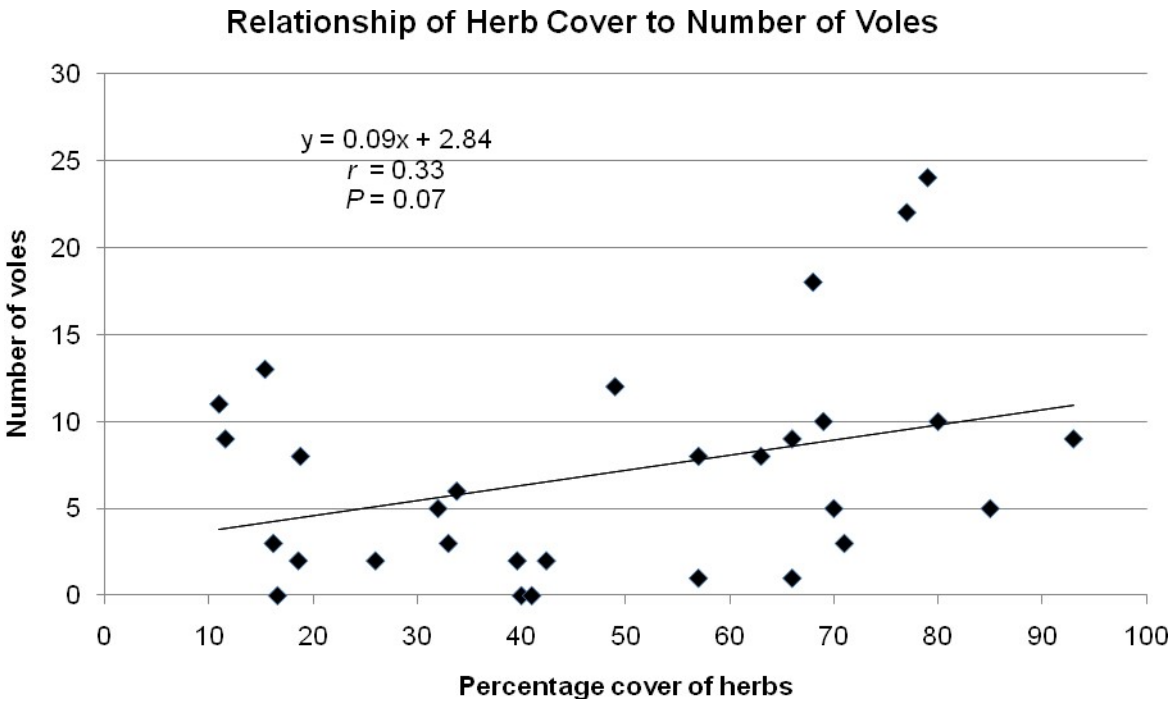


Figure 8. Mean (*n*=3) abundance of long-tailed voles per ha in grass and non-grass habitats in 2005 and 2006.

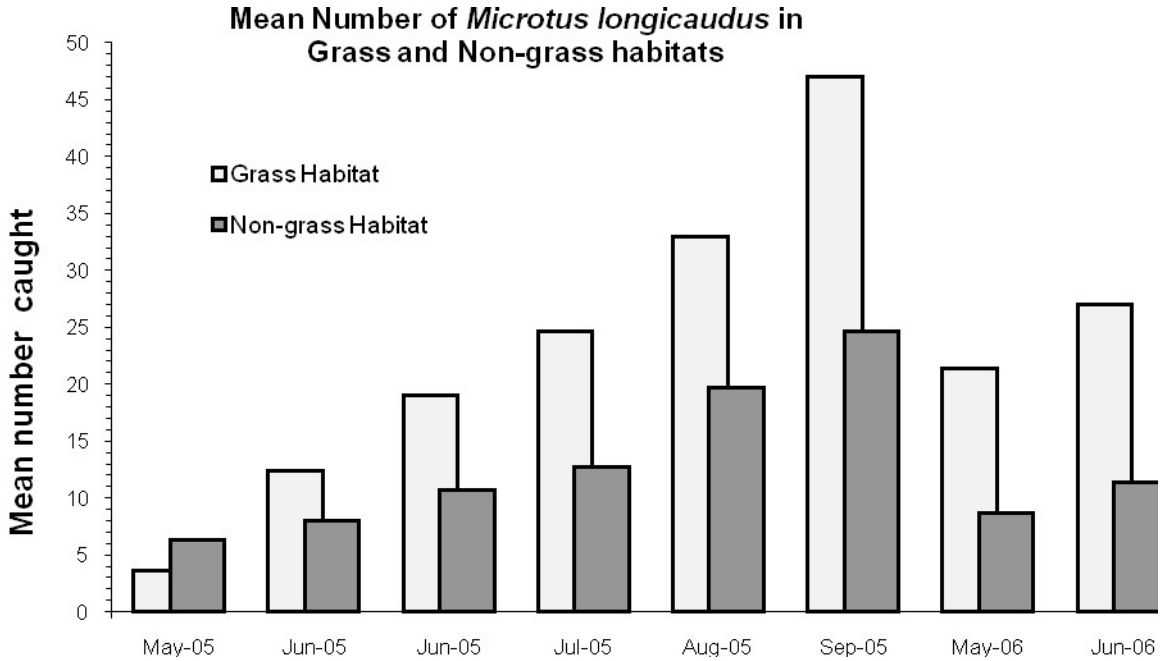


Figure 9. Mean (*n*=3) abundance of long-tailed voles) per index-line in grass and non-grass habitats in 2008 and 2009.

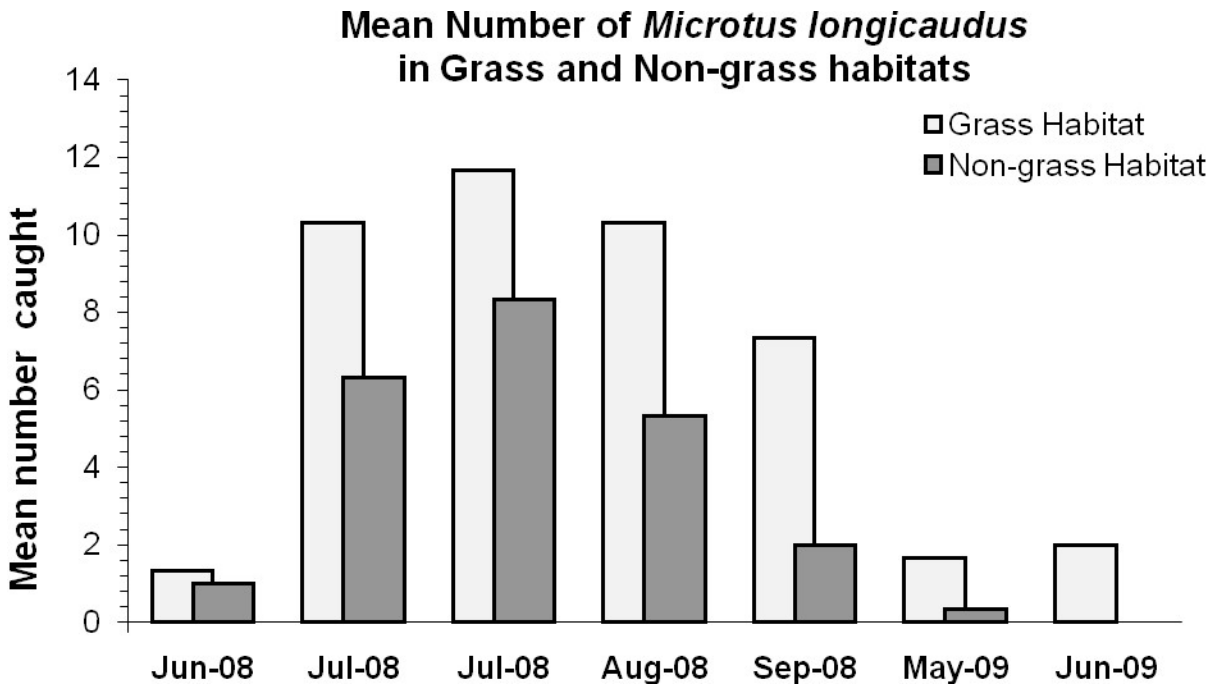
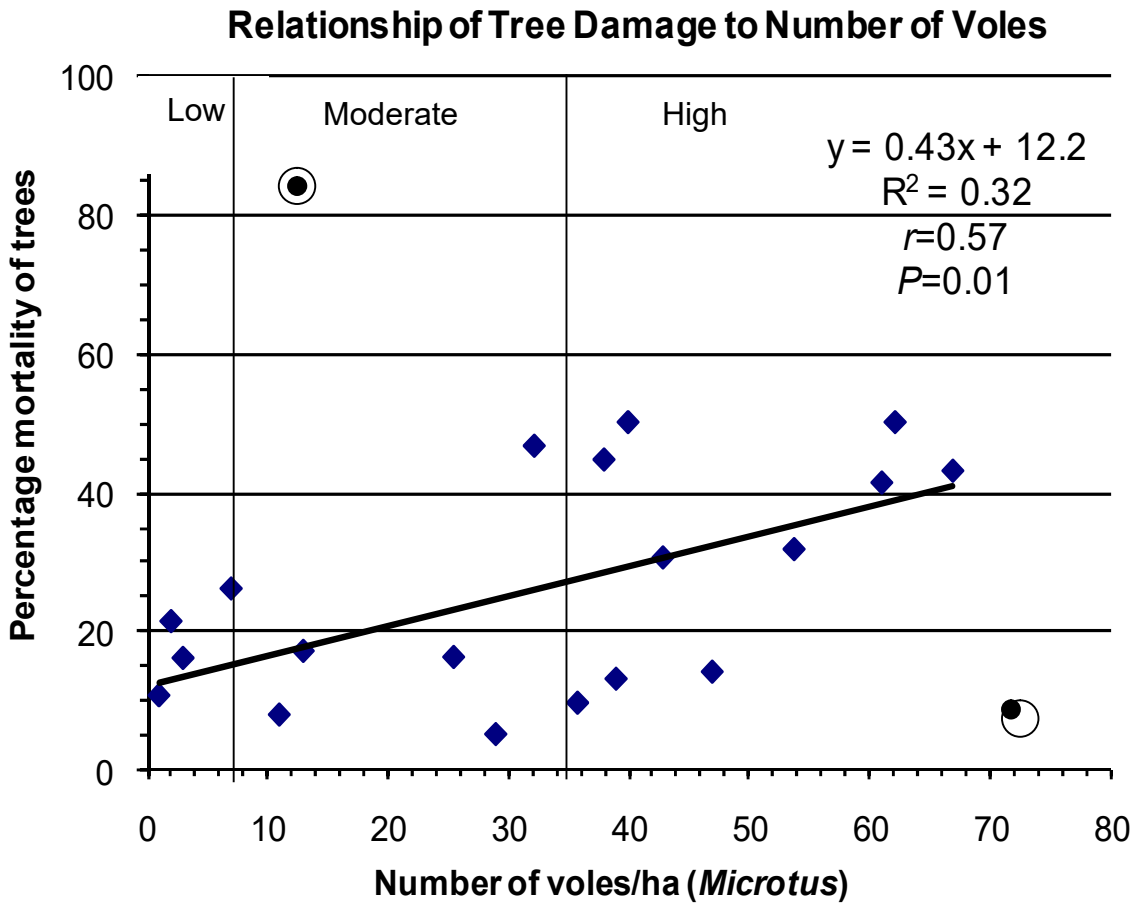


Figure 10. Linear regression relationship of percentage tree mortality to abundance of voles. The two datapoints with circles (outliers) were not part of the analysis.



Number of voles/index-line	Number voles/per ha	Risk of damage to trees
< 5	< 7	Low
5-10	7-34	Moderate
11-20	35-88	High
> 20	> 88	Very High

Regeneration Delay Extension in Areas with Known Vole Populations

Situations and circumstances where these clauses are intended to apply:
These clauses are intended to be used within LP's operating area within drainages where there are high populations of voles causing significant damage to cut block plantations.

The area outlined below has been identified by a qualified Small Mammal Researcher Dr. Tom Sullivan as having a high population build-up of voles. Drainages may be deemed to be added should they be identified by a professional as having a high population build-up of voles. A letter providing their professional opinion will be retained on file.

Within Landscape Unit G26, in the ICHmk1, ICHmw1 and MSdk the regeneration delay can be extended up to 7 years after the commencement of harvest.

SUPPORTING DOCUMENTATION:
VOLE POPULATIONS AND TIMING OF PLANTING CUTOVER SITES

Voles of the genus Microtus are considered one of the major mammalian pests in coniferous tree plantations in the Golden TSA. Two species of Microtus, the long-tailed vole and the meadow vole, are implicated as major consumers of tree seedlings. A third species, the heather vole, is also present in these small mammal communities but exists at low abundance. Voles will feed on tree seedlings and saplings, with highest damage during winter months of peak years in abundance. These rodents feed on bark, vascular tissues, and sometimes roots of tree. This damage results in direct mortality from girdling and clipping of tree stems or reduced growth of surviving trees which have sub-lethal injuries. The fertilization regime of nursery-raised seedlings enhances their palatability and nutrition, thereby predisposing them to preferential feeding over wildlings that arise from natural regeneration. Voles also feed preferentially on particular tree species: Lodgepole pine, Douglas-fir, and spruce.

How many voles need to occur in a given plantation to create a serious damage problem? A risk rating for feeding damage to trees, based on an index-line or grid survey of voles, is derived from the significant positive relationship between percentage tree mortality and abundance of Microtus voles.

Number of voles per ha Risk of damage to trees:

< 7 Low
7 – 34 Moderate
35 – 88 High
> 88 Very High

To determine when voles will be a problem, vole populations were monitored on sampling grids for six years (2004-2009) at Roth Creek and Glenogle Creek, since the time of harvesting, to follow how these rodents respond to successional change and reach densities capable of serious feeding damage to newly planted trees. Over 29 trapping periods, the long-tailed vole was the most abundant microtine with a total of 625 individuals captured (96.7% of total Microtus), followed by 21 meadow voles, 113 red-backed voles, and 104 heather voles. Populations of long-tailed voles were low in the first year after harvest with mean numbers < 5/ha. Mean numbers in the second post-harvest year reached 15/ha and had a strong annual cycle with up to 43 animals/ha in September. Annual maximum densities of 49-84 voles/ha were recorded in 2006, which seemed to be the peak populations on the three grids. However, in the fourth year (2007) since harvesting, numbers of long-tailed voles declined, particularly on grids D and F, while grid E remained high reaching an annual maximum of 82/ha. This decline deepened in 2008 and reached extirpation on two of three grids in 2009.

Feeding damage is associated with:
1) High populations of voles,
2) Early successional habitats after harvesting, and

3) Trees planted shortly after harvesting.

What to do?
If planting of cutover sites does not have to be done immediately after harvest, to avoid competing vegetation, or for other reasons, then:
1) Delay planting until at least the 4th or 5th year after clearcutting,
2) Plant fast growing species Pl and larch > Douglas fir > spruce,
3) Use larger stock, and higher densities, where possible.

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Free Growing Assessment of Trees with a Visible Stem Wound

This clause is intended to be used within LP's operating area where there is an obligation to establish a free growing stand, the type of Free Growing Damage being assessed is a wound, the tree is at least 15 years old and greater than 4 meters in height.

SUPPORTING DOCUMENTATION:
Barnes, V.G. Jr., and R.M. Engeman. 1995. Black bear damage to lodgepole pine in central Oregon. Northwestern Naturalist. 76:127-129.

Miller, Richard E.; Anderson, Harry W.; Reukema, Donald L.; Max, Timothy A. 2007. Growth of bear damaged trees in a mixed plantation of Douglas-fir and red alder. Res. Pap. PNW-RP-571. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 29 p.

Radwan, M.A. 1969. Chemical composition of the sapwood of four tree species in relation to feeding by the black bear. Forest Science. 15: 11-16.

Shea, K.R. 1967. Effect of artificial root and bole injuries on diameter increment of Douglas-fir.

Weyerhaeuser For. Pap. 11. Centralia, WA: Weyerhaeuser Company. 11 p

Impact of Partial Girdling by Mammals on Tree Growth and Survival

Several species of mammals feed on the bark and vascular tissues of coniferous trees. Species include voles of the genus *Microtus*, snowshoe hares, red squirrels, porcupines, and bears (both black and brown). Regardless of the pest species, removal of bark and vascular tissues likely has the same impact on tree growth and survival. The impact of this feeding damage, by hares and squirrels, on tree growth and wood quality in young lodgepole pine concluded that severe partial girdling (50-99%) of stem circumference suppressed diameter and height growth of small-diameter (4.1-6.0 cm) trees, but had no effect on larger stems (6.1-8.0 cm). In some situations, diameter increment increased significantly with degree of partial girdling. This trend may be related to animals preferentially feeding on more vigorous stems.

For bear damage to coniferous trees, nearly all reports concluded that vigorous stems are preferred over those growing in dense stands or on poor sites. Severe partial girdling (> 50%) of larger stems by bears and porcupines seems to be the level where impacts on growth and survival may be highest.

Thus, a 50% partial girdling level would seem reasonable as a cut-off for acceptable trees in free-growing surveys. Other damaging agents such as Warren's root collar weevil and Atropellis canker that affect stem circumference in terms of partial girdling suggested that 60% likely resulted in a significant reduction

in diameter and height growth of lodgepole pine. Please see other references in the publications below (attached as pdfs).

Sullivan, T.P. 1993. Feeding damage by bears in managed forests of western hemlock – western red cedar in midcoastal British Columbia. Can. J. For. Res. 23: 49-54.

Sullivan, T.P., H. Coates, L.A. Jozsa, and P.K. Diggle. 1993. Influence of feeding damage by small mammals on tree growth and wood quality in young lodgepole pine. Can. J. For. Res. 23: 799-809.

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***Armillaria ostoyae* Root Disease (DRA)**

Brushing deciduous species is not recommended on DRA sites as brushed stumps increase the inoculum on site and contribute to the spread of DRA.

This clause is intended to be used within the ICHmw1 of LP's operating area. A survey must determine that a minimum of 20% of the SU area contains Armillaria (*Armillaria ostoyae*) Root Disease (DRA) infestations. Plantation tree species that have a low-moderate host susceptibility rating (Cw, Lw, Pli, Sx, Pw, Ep, At, Ac) for DRA should be considered first.

This clause is restricted to not more than 100 hectares of the NAR managed at one time by LP.

Within LP's operating area, the following standards apply:

1. Where stump removal is not a treatment option:
   - Up to 25% of any mixture of the following deciduous species (At, Ep, Ac) will be considered preferred well-spaced and free growing trees;
   - Cw and up to 20% of Sx will be considered preferred well-spaced and free growing trees.
   - Coniferous trees with high host susceptibility (Fdi, Bl, Hw) should not individually contribute to more than 50% of the initial planting species mix.
2. Where stump removal is a treatment option:
   - Cw and up to 20% of Sx will be considered preferred well-spaced and free growing trees.
3. The free growing surveyor will employ the following when assessing the acceptability of deciduous species:
   - The surveyor will track the well-spaced deciduous trees in the survey plot;
   - The surveyor will track preferred deciduous trees that meet the free growing or potentially free growing criteria. Preferred deciduous trees will be treated exactly as conifers (i.e. consider their competitive effects on other trees); and
   - Free growing or potentially free growing deciduous trees will not contribute to the number of "countable" deciduous trees for the purpose of determining if potential free growing trees may be accepted as free growing.
   - The surveyor will use the Free Growing Damage Criteria for Deciduous Trees outlined in Appendix 11 of the Free Growing Procedures Manual (April 2013).

SUPPORTING DOCUMENTATION:

Cleary, M., B. van der Kamp, and D. Morrison. 2008. British Columbia's southern interior forests: Armillaria root disease stand establishment decision aid. *BC Journal of Ecosystems and Management* 9(2):60–65.

Adjustment to Stocking Standards ID # 1033753

This clause is intended to be used within LP's operating area where a survey determines that within the standards unit the dominant Soil Moisture Regime in the ESSF wc2 06/07 is subhygric.

The following per hectare well-spaced and free growing Stocking Standards will apply:

Target	MIN pa	MIN p
1000	500	400

Snow Press, Snow Creep, and Snow Slide Damaged Plantations

Conifer establishment in areas affected by snow press, snow creep and/or snow slides establish in clumps (i.e. uniform spacing is atypical).

This clause is intended to be used within LP's operating area where a survey determines that within a standards unit snow press, snow creep, and/or snow slides have rendered at least 30% of the preferred well-spaced and/or free growing trees as unacceptable.

The inter-tree spacing in these areas will be treated in the same manner as the "problem vegetation types" noted in version 3.0 of the Selkirk Forest District FSP Stocking Standards.

The inter-tree spacing will be reduced to 1.3 meters.

Considering Balsam Fir a Preferred Species

Anecdotal evidence indicates that Balsam Fir is not being damaged by snow press/snow creep/snow slide. Young Balsam Fir trees are more malleable and able to bend (as opposed to break) under these heavier than normal snow load events.

Situations and Circumstances where this clause is intended to apply:

This clause is intended to be used within LP's operating area where a survey determines that within a standards unit snow press, snow creep and/or snow slides have rendered at least 30% of the preferred well-spaced and/or free growing trees as unacceptable.

Up to 50% of the Balsam Fir may be considered a preferred species.

Regeneration Delay Extension

This clause is intended to be used within LP's operating area where LP was granted permission to postpone a Cutting Permit under section 58.21 subsection 1 of the *Forest Act* and harvesting has commenced on the setting. On the unharvested portion of the setting the Regeneration Delay will be rounded up to the number of years the postponement was granted. For example, if the CP was postponed for 9 years and three months, the Regeneration and Free Growing Extension will equal 10 years.

Retention of Windrows and Slash Piles

This clause is intended to be used throughout LP's A17645 and A82664 Forest Licenses. As described in section 5.2.7 of the FSP document.

SUPPORTING DOCUMENTATION:

Gyug, L.W. 1994. Wildlife use of logging debris piles in clearcuts. Final Report. B.C. Ministry of Environment. Penticton, B.C. 45 p.

Klenner, W. and T.P. Sullivan. 2003. Partial and clearcut harvesting of high-elevation spruce-fir forests: Implications for small mammal communities. Canadian Journal of Forest Research 33: 2283-2296.

Lisgo K.A., F.L. Bunnell, and A.S. Harestad. 2002. Summer and fall use of logging residue piles by female short-tailed weasels. USDA For. Serv. Gen. Tech. Rep. PSW-GTR-181. Pp. 319-330.

Sullivan, T.P. and D.S. Sullivan. 2001. Influence of variable retention harvests on forest ecosystems: II. Diversity and population dynamics of small mammals. Journal of Applied Ecology 38: 1234-1252.

Sullivan, T.P., D.S. Sullivan, and P.M.F. Lindgren. 2008. Influence of variable retention harvests on forest ecosystems: Plant and mammal responses up to 8 years post-harvest. Forest Ecology Management 254: 239-254.

Sullivan, T.P., D.S. Sullivan, P.M.F. Lindgren, D.B. Ransome, J.G. Bull, and C. Ristea. 2011. Bioenergy or biodiversity? Woody habitat structures and maintenance of red-backed voles on clearcuts. Submitted to a scientific journal.

Sullivan, T.P., D.S. Sullivan, P.M.F. Lindgren, and D.B. Ransome. 2011. Conservation implications of woody debris as habitat structures on clearcuts: Abundance and diversity responses of mammals. Submitted to a scientific journal.

Sullivan, T.P. and D.S. Sullivan. 2011. Woody debris, voles, and trees: Influence of habitat structures (piles and windrows) on long-tailed vole populations and feeding damage. Submitted to a scientific journal.