An assessment of wildlife habitat and conservation priorities along the Lardeau River corridor




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Executive Summary

This reconnaissance-level project has mapped and briefly described key habitats [1], examined their relative threatened or protected status, provided an overview of wildlife, and looked briefly at key ecological processes for the purpose of identifying general conservation priorities for the Fish and Wildlife Compensation Program in the Lardeau River watershed. The focus of the project has been the main valley riparian zone and lower slopes. Locations of identified key habitats are shown on Maps 1, 2, and 3 with details on each site on Table 2, 3, and 4. Discussion of findings, summary and recommendations are addressed in the written report.

Wetlands, in general, emerge as high priorities for conservation action in the project area, in being important contributors to biological diversity, sensitive to a number of impacts, and poorly protected. Additional key habitats include "exceptional" old-growth, future old growth sites, and travel focal zones. Alpine habitats and species, though not originally a project focus, also emerge as priorities due to recognized sensitivity and predicted threat in the face of climate warming.

The highest-priority geographic locations for the next ~ 10 years appear to be the northernmost and southernmost ends of the project area that are dominated by private land: the Trout Lake flats and the Lardeau-Duncan flats. Lands along the Lardeau River and around Trout Lake are mainly crown-owned, with significant areas along the Lardeau River protected in the Goat Range Park (GRP), the proposed "Goal 2" Protected Area (KBHLP 2007), and partially protected under mountain caribou special management areas (SARCO 2008).

Four general categories of potential conservation initiatives emerge from the overview:
(1) Private land acquisition, (2) private land stewardship, (3) "hands-on" projects, and (4) research, planning, monitoring, and inventory.

[1] Key habitats include keystone habitats and special habitats as defined in Austin et al (2008)
Key species includes keystone species, Species At Risk, and others of special concern

TABLE OF CONTENTS

Executive Summary ……1
Introduction…….....3
Objectives……3
Project Area ……....3
Methodology……...5
Results…….7
Key Species ……..7
Key Habitats……9
Key Ecological Processes……..14
Land ownership, management and "threat" status….....14
Management Implications and Recommendations…..……..16

List of Figures

Figure 1. Project Location……..4

List of Appendices

Appendix A. Tables 1 to 6 and Maps 1 to 3 detailed in list below
Appendix B. Photographs

List of Tables

Table 1. Species at Risk in the Lardeau River watershed
Table 2. Yellow-listed and other vertebrate species in the Lardeau River watershed
Table 3. Wetlands identified in the Lardeau River corridor
Table 4. Old growth and near-future old growth in the Lardeau River corridor
Table 5. Travel focal zones identified in the Lardeau River corridor
Table 6. Special habitat sites
Table 7. Private land with high wildlife habitat value, Lardeau River corridor

List of Maps

Map 1. Lardeau-Beaton Habitat Assessment
Map 2. Lardeau-Beaton Habitat Assessment
Map 3. Lardeau-Beaton Habitat Assessment

INTRODUCTION

The Lardeau River riparian and lower slope zone, known locally as the Lardeau River corridor, is regionally recognized for its high ecological significance (KBHLP 2002). Notable characteristics include the river's relatively wild, un-dammed condition[2] (Miles 2002), its critical fisheries values its associated fish-dependent animal communities, its apparent role as a landscape travel corridor for large mammals, including several species at risk), and its examples of mature and old-growth riparian forests (Holt and McKillop 2006). To some extent the valley is representative of the Duncan and Arrow Lakes ecosystems prior to flooding, albeit a narrower, smaller-scale version. It could be said to complement the present-day habitat function of the Duncan and Arrow for wide-ranging wildlife species.[3] For these and other reasons the Fish and Wildlife Compensation Program is interested in potential opportunities for enhancement and protection in this area under its mandate to compensate for losses resulting from dams. This project has been an effort to identify project opportunities for improving or protecting biological diversity and connectivity in the Lardeau corridor using a transparent approach consistent with current ecological principles as utilized in Austen et al 2008.

OBJECTIVES

Specific objectives have included:

- To map and / or describe some of the key[4] habitats, key species, and key ecological processes in the riparian and lower slope zone between Beaton and Kootenay Lake
- To review ownership, management or protected status, and apparent future threats for key habitats
- To identify apparent conservation priorities for the FWCP and a list of potential projects based on a synthesis of the above.

PROJECT AREA

The Lardeau River-Beaton Creek watershed lies in the Central Selkirk Mountains in South-eastern B.C., approximately parallel to the Duncan valley (Figure 1). This cool, wet, high-snowfall region is characterized by rugged topography, high snowfall and rainfall, with a scarcity of land area in broad low-elevation valley bottom sites. The focus area of the present project has been the main river riparian zone and the lower slopes from Beaton to the head of Kootenay Lake, along the Lardeau River, a distance of approximately 100 kilometres. Biogeoclimatic variants in the project focus area include ICHwk1, and ICHmw, with a small area of ICHdw2 at the far south end near Kootenay Lake.

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[2] upstream from confluence with Duncan

[3] Individual and population level

[4] "key includes "keystone habitats" as defined in Austen et al (2008) in addition to "special habitats" as defined in same document.

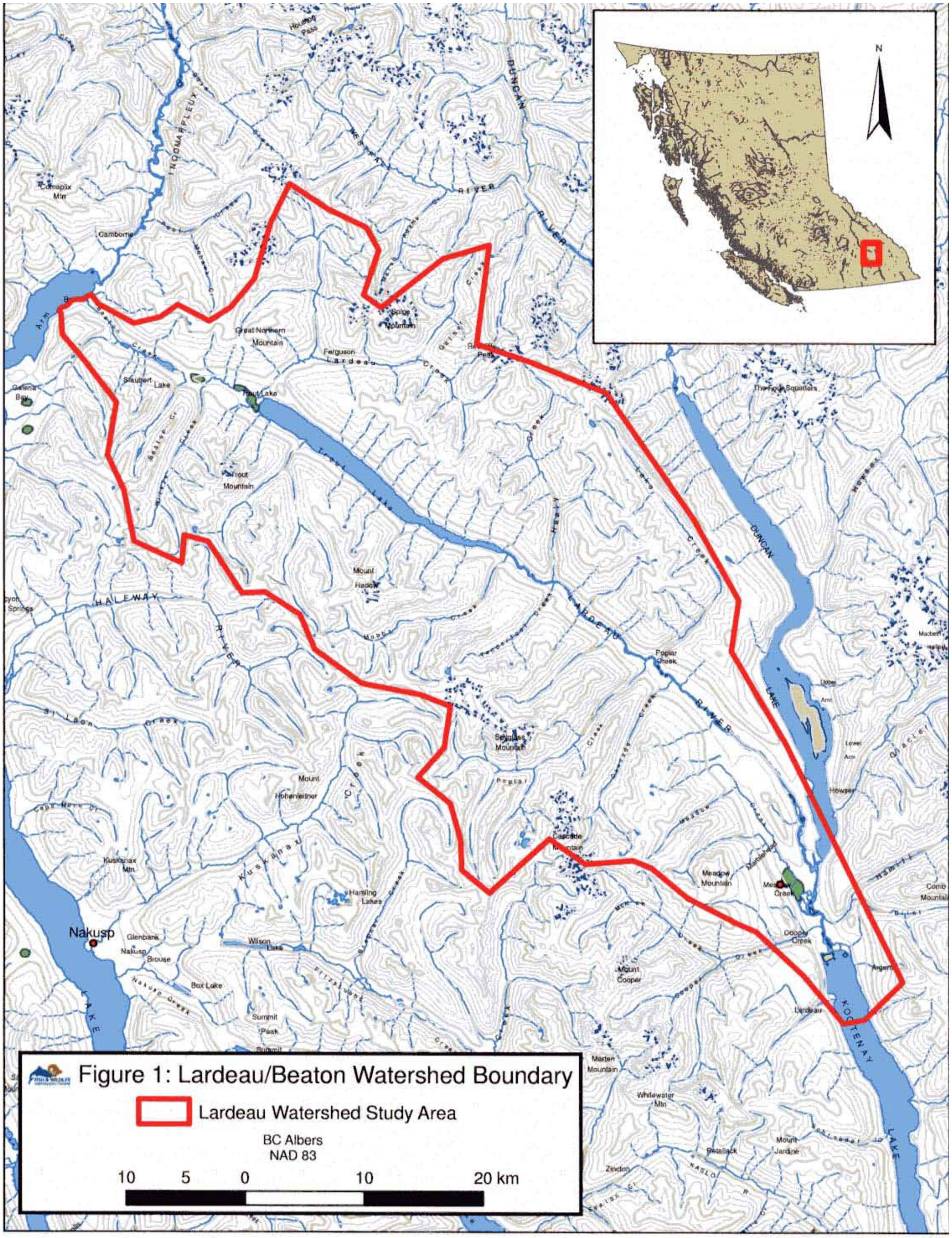

Figure 1: Lardeau/Beaton Watershed Boundary

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METHODOLOGY

Following consultation with FWCP staff through a work plan review, the project utilized all available information on wildlife use, including use by Species At Risk (SAR), along with pre-field habitat typing of air photos, topographic maps, (TRIM), and forest cover maps to undertake a species/habitat use overview, to identify potential and known key habitats and key processes, and to design a field reconnaissance strategy. Later, composite base maps were created by FWCP GIS staff to portray background and study area context using TRIM and Vegetation Resource Inventory (VRI 2007) data. Land ownership information came from a variety of sources; details available from FWCP GIS staff. Wildlife and habitat data sources included the B.C. Conservation Data Centre (CDC 2007), various regional and provincial government reports and regulations (KBHLP Caribou 2002 and2004, GAR Ungulate Winter Range Order (FRPA) , informal communications with MOE staff (Mowat, Antifeau, DeGroot), author records over ~ 30 years, records provided by other Lardeau valley residents (Spitler, Lawrence, Bekker, Gates, Rogers), and all available wildlife research and inventory reports from the study area: (Hamilton and Herbison 1997, Hamilton and Wilson 2000, Hamilton 2002-2008), Herbison 1994, 1997, Holt and McKillop 2006s, Hartman 1969, Herbison 1973, Poole et al 2002, Proctor et al 2004, Machmer pers.com, and Gaynor et al (2007).

Criteria used for characterizing "key" habitats included:

- rarity or relatively rarity in the project area
- serving critical or uniquely important functions in the landscape for wildlife
- known or very likely use by Species at Risk
- sites of high species richness where not captured by above

Habitat classes (features) in the project area that meet the above criteria include:

- Wetlands (floodplains, swamps, marshes, fens, and bogs)
- Exceptional old growth
- Older mature forest with high future potential as old growth
- Travel focal zones
- Special habitats

The sites shown on Maps 1, 2, and 3 were briefly described by walk-though reconnaissance (due to project scope most fieldwork was within an hour's walk of a road.). Records included habitat type, (plant community, structural stage), estimates of key attributes (such as tree diameters, % snags, or structural diversity), wildlife suitability and obvious wildlife use. Descriptive criteria and terms were compatible with BC Resource Inventory Standards Committee for describing terrestrial ecosystems and habitat suitability as indicated on Forms FS 882 (1)(3)and(5) (RISC 1998). Site locations were originally recorded on 1:20,000 maps using unique reference numbers combined with upper case letter symbols indicating habitat class. This was transferred to digital forma and printed in hard copy at 1: 30, 000. It should be noted that wildlife observations were limited by project budget and scope to being incidental to site descriptions.

Wetlands were classified using the draft provincial standard Mackenzie (1999). Swamps. Marshes, Bogs, Fens, and Active channel flood groups (Classes), were separated based on factors such as water regime and depth, percentage of shrubs vs. graminoids vs. open water, or

presence/absence of key plant species as Mackenzie (2002). Locale-specific plant community descriptor names (subclasses) were created within each broad class as in Herbison (2003). This system is similar to the methodology used by Ross et al (2006) in the East Kootenay. Field observations suggested the boundaries between wetland classes were sometimes blurry (for example marsh wetlands can be surrounded by and merge into swamps or vice versa) and that classes can change over time, (even in as little as one year) depending on flood regime and other factors.

Forest ecosystems were described by visual estimates of species composition, structural diversity ranking, range and average of tree diameters, percentages of snags/coarse woody debris, lichen species diversity and abundance, and "old growth ranking". The definitions used for ranking old growth are consistent with definitions used by Fraser et al 1990, Parminter 1991, Quesnel 1994, Radies et al (2008), Herbison 1994, and Holt and McKillop 2006. The highest-ranking or "exceptional" stands are characterized by very old age (estimated 300 + years), large trees, (i.e., majority of boles 100 cm dbh, and occasional boles approaching 200 cm dbh), a high percentage of standing and down dead trees in a range of decay classes, overall high structural diversity in stands, and high lichen, fungus, and bryophyte diversity. Stands ranking highly based on these criteria were assigned OG symbols on maps. Stands ranking less highly as old growth – typically including most of the above characteristics except for bole size (over 50 cm dbh dominant, but few over 100 cm dbh) - were assigned OG(OM), OG/OM or OM/OG symbols indicating relative old growth ranking (here listed from greatest to least).

Old growth stands at mid and high elevations in the project area are shown only by colour-theming on Maps 1, 2, and 3. Most of these stands do not meet the bole diameter criteria described for OG above, but many meet the other criteria ((e.g. old age, high % decay, structural diversity, abundant lichens). Some of them have high habitat value for mountain caribou. (Herbison 1997, Hamilton and Wilson 2002).

The term **'special habitat'** in this project is applied to important habitats that do not fit into any other category, consistent with RISC (2000). Examples include snake hibernaculae, raptor nest sites, mountain goat kidding and nursery group areas, or mineral licks. caves, rock outcrops, mineral licks, mud wallows.
Special habitat features identified in this project represent only a small fraction of the total inventory. They are assigned reference numbers with no letter symbol on Maps 1 to 3 and are briefly described in Table 5.

Travel focal zones were defined as locations where daily, and/or seasonal travel by large mammals appears to be concentrated due to constraints at close or distant scales. Examples of constraining influences that may affect travel patterns by large mammal (the extent depending on species, amongst other factors) include cliffs, steep talus or rockslides, very dense young stand conditions, large openings, and some forms of human disturbance.

Potential travel zones were identified prior to fieldwork on the basis of topographic, vegetation/forest cover, land use features, and in some cases previous observations. The lower slope and valley bottom sections of the hypothetical routes were then checked in the field for signs of large mammal use (well-worn to "more than one set of tracks", and/or or direct visuals

of animals 'on the move' on that route). Most of the upper / mid elevation 'probable' or hypothetical continuations of these zones have not been documented in the field; they are based on interpretations of topography and stand features. Confirmed T's are shown in red, with potential travel zones in yellow, on Maps 1-3.

Site-specific field details were organized into tables grouped by habitat class: (Tables 3, 4, and 5). Locations were digitized and added to the GIS layer which by then included forest age and land ownership.

In the early stages of the project, knowledgeable local individuals, clubs, the RDCK representatives for Area D and Area B Regional Districts and MOE were contacted to inform them of the project objectives and to invite relevant input. Contacts included Grant Trower, Gail Spitler, Jim Lawrence, Andy Shadrack (RDCK rep), Trout Lake Store Owner, CSRD OCP, Loni Parker (CSRD rep), Ted Antifeau and Garth Mowat (MOE). The draft Electoral Area 'B' Official Community Plan"(OCP) was reviewed for the area north of Trout Lake. The Draft Terms of Reference for the Area 'D' Community Plan and the Area 'D' Survey Results was perused relevant to the south end of the study area.

RESULTS

KEY SPECIES

Species listed provincially, federally or globally "At Risk" (SAR) or 'Of Special Concern'
There are 110 Blue and Red Listed species on record in the B.C. Conservation Data Centre (CDC) database for the Kootenay Lake Forest District. Twenty-seven (27) are vertebrate animals, 52 are plants, and the remaining 31 species are molluscs and insects. Of the 27 listed vertebrates, 23 are known to use the Lardeau-Beaton project area. Only 3 of the red-listed plants are confirmed to occur in the project area but this figure could change with l inventory effort. Information is largely lacking on the occurrence of most insects, and molluscs.
See Table 1, Appendix A, for Species at Risk. See Table 2 for other species. Scientific names, excluded below, are included in the tables.

Red-listed (endangered) **mountain caribou**[5] are the most high-profile Species at Risk in the study area at present. The Lardeau river corridor lies in the centre of the range occupied by the Central Selkirk caribou (author estimate of ~ 100 from a census count of 96 from Hamilton pers.comm. (2008)), and may serve a critical connectivity function between east and west parts of the population. As mentioned, many of the mature/old and old-growth stands showing (colour-themed) on Map 2 and 3 are used by caribou. There have been recent government efforts to improve regulations for caribou and habitat in the project area over the previous Kootenay Boundary Higher Level Plan (KBHLP) by the B.C. Species At Risk Office (SARCO)) . Nothing has yet been enacted legally. For an update on provincial and regional caribou recovery see the SARCO website ilmbwww.gov.bc.ca/sarco/mc/index.html.

Blue-listed **grizzly bears** congregate along the Lardeau River riparian zone below Gerrard during and after the Kokanee spawning run from late August to early November. It is known that at least some bears travel long distances to and from the Lardeau riparian zone (One bear

[5] Scientific names for species are provided in Table 1

was tracked by the author to upper Healy Creek from the Lardeau River in late October (2001) Grizzlies also utilize parts of the Lardeau riparian zone in spring.

Blue-listed "obligate aquatic" species present in the project area include **great blue heron, painted turtle**, and **bittern. S**pecies "of special concern" **Western toad** is found throughout the project area. Blue-listed **bull trout** spawn in at least one tributary of the Lardeau River and non-listed but world-famous **Gerrard rainbow** trout spawn in the Lardeau River just below Trout Lake.

Blue-listed **Townsend's' big-eared bats** appear to use the riparian zone of the lower Lardeau-Duncan flats extensively, **a**long with caves on nearby bluffs (Hill et al 2005). Red-listed **Lewis's woodpecker** use riparian forests on the Lardeau-Duncan flats (Spitler (pers.com.). Rare but documented red-listed migrants include **American avocet** and **Forster's tern**, on the foreshore of the Lardeau-Duncan flats.

Blue-listed **wolverine**, and **fisher** use the study area but are believed to be only transiently associated with the riparian zone and lower slopes.

It is speculated that additional red-listed species could expand their range into the project area if the climate becomes warmer and drier – for example, **yellow-breasted chat, short-eared owl** or red-listed **Northern pocket gopher –** in the manner that wild turkeys, turkey vultures, bobcats, and Lewis's woodpeckers appear to have, over the past decade.

There are known to be at least five r**ed and blue -listed plant communities and at least two additional listed plant species** in the project area, as noted in Table 1. This is a partial list, based only on previously existing information and areas covered during the present project. It appears there may be long list of additional blue-listed plants in the area; only red-listed plants and a few selected blue-listed have been addressed in Table 1. Legal listing aside, all plants that are specialists in small, isolated rare habitats are, in fact, rare, and very vulnerable. Examples of such plants include Cladina rangiferina lichens, found (locally) only associated with dry rock outcrops and old rock slides, and plants found only in restricted wetlands, such as buckbean (Menyanthes trifoliata) bog lady slipper (Calypso calculus), or Cotton grass (Eriophorum augustifolium).

There is a great deficiency of information on the occurrence of red and blue- listed molluscs, dragonflies, moths and butterflies in the project area.

Other vertebrate species

A number of species in addition to grizzly bears gather in unusually dense concentrations along the Lardeau River River below Gerrard during Kokanee spawning season. This includes black bears, golden eagles, bald eagles, river otters, mink, and common mergansers. At the mouth of the Duncan-Lardeau river, on Kootenay Lake, gulls, loons, grebes, as well as eagles congregate at this time, often arriving several weeks prior to the peak fish run and staying weeks past it, as the fish die

Yellow- listed ungulates associated with the project area include elk, white-tailed deer, mule deer, and moose. Elk and white-tailed deer move along the Lardeau and utilize alluvial sections of the riparian zone along with upland areas in non-winter seasons (Poole 2001). Mule deer utilize upland areas throughout the project area; their numbers in the project appear to have increased over the past 2-3 years after being down in the late 1990s-early 2000s. (pers.obs.). Only the far south end of the project area is currently considered critical winter range for deer and elk in government regulations (GAR 2002) due to the limiting influence of deep, long snowpacks throughout the rest of the watershed. Moose increased in number during the late 1980s in the Lardeau and Duncan valleys, and since then have wintered regularly along the Lardeau River riparian zone. Carnivores utilizing the riparian zone and lower slopes in addition to grizzly and black bear include cougar, lynx, marten, coyote, wolf, and bobcat. Coyote and wolf numbers are evidently high throughout the project area at present, according to data collected by DeGroot, Mowat et al (2007) and author impressions from fieldwork and other casual reports. Cougars appear to be at low to normal levels. Bobcats appear to be more numerous than in the past, at the south end of the project area, based on casual impressions and incidental reports. (It is rumoured that several bobcats per year have been shot in the last few years to protect chickens (source anon, south end of project area). On this note, the same source reports hawks and owls meeting a similar fate.)

Non-listed small mammal, amphibian and reptile species in the project area of concern note due to their obligate dependence on wetlands include: beaver, muskrat, mink, Richardson's water vole, and water shrew, pacific treefrog, and northern long-toed salamander. Non-aquatic small mammals reptiles and amphibians that may be vulnerable due to limited occurrence or other threats include most bat species, northern alligator lizard, 'woodchuck', northern flying squirrel, most species of terrestrial shrews and moles, hoary marmot, and pika. The latter two may be of particular concern due to the predicted shrinking of alpine habitats due to a warmer climate.

Over 200 bird species use the Lardeau River watershed, as documented by annual Christmas bird counts (Herbison 1980s, Spitler 1990s-2000s), year-round records kept by various individuals (Herbison 1972, 1997, 2006, and Bekker, Gates, late 1980s) and regular point count surveys undertaken by Gail Spitler unpubl.2007). Most information on birds in this report comes from the southern portion of the project area. The most extensive bird data available appears to be that collected in the Trout lake area for Roca mines

KEY HABITATS

Key habitats are shown on Maps 1, 2, and 3 using the following symbols:

- Wetlands - W
- Old growth and old mature (near-future old growth) - OG, OM/OG
- Travel focal zones - T's, and
- Special habitats - number only

Details on each site are grouped by habitat class in Tables 3, 4 and 5. Locations are shown on 1:30,000 scale maps, Maps 1, 2, and 3. Tables and maps are provided in Appendix A.

Summary of findings by habitat class

Wetlands

Wetlands - known, world-wide, for their disproportionate contribution to biological diversity - are an obvious rarity in the Lardeau-Beaton watershed. They represent less than 2 % of the total watershed area and are only somewhat less rare along the valley bottom, totaling very roughly 500 hectares based on the breakdown below. The six broad wetland classes identified are: Alluvial floodgroups and Swamps, (the two most common), less commonly Marshes, Anthro-modified marshes, and Deep beaver ponds, and, most rarely, Bogs. Within each class there are several plant community types, also described briefly below.

SUMMARY OF WETLAND HECTARES

Subclass and type	**Hectares *approx***	**W Sites**
Swamps (flooded)	100	Ws 2,10,13,22,
Swamps (Lentic)	150	Ws 3,4,5,6a,6b, 9,11,15b
Marshes equ/carex	35	Ws 15b, and 33,35,26
Marshes cattail	35	
Marshes bulrush	19	Ws 18, 34
Bogs	12	W19
Deep beaver ponds	10	Ws 7, W31
Fluvial Active channel marsh wetlands	50	Not mapped. Available on request.
Fluvial Active channel Shrub-sapling Low bench	120	Not shown. Maps available on request
TOTAL	**532**	

Plant community subclasses
Species and proportions vary from site to site. Subclasses/plant communities here are 'lumpings'

Fluvial Wetlands (Low-bench flood groups)
Five main subclasses:

- Low-density young pioneer black cottonwood/sandbar willow seedlings on new gravel bars, < 2m ht < 10 yrs
- Dense sapling cottonwood, Pacific willow, (red osier dogwood, alder beginning). Main channel. 2- 4 m. ht. 10-20 yrs
- Dense alder / willow /osier/rose thickets (no Cottonwood). Side channels, backchannels. 2 – 6+ m. ht5-20 yrs old
- Cottonwood dominated 4-10 m. ht. 20-30 yrs old. Main Channel
- Narrow bands of marsh wetland development (sedges, horsetail,+) along flooded channels

Low-bench flood groups are identified by solid yellow polygons along the Lardeau River, found on Map 2 and Map 3. They are not assigned reference numbers on these maps, but references are recorded on field maps and available on request.

Lentic Wetlands
Swamps
Three main subclasses:

- Horsetail-Sedge. Trees (Cedar) sparse, high % snags High % open water most of season. Low % shrubs
- Cottonwood- Cedar - skunk cabbage –high bush cranberry. Minimal open water, high tree and shrub cover.
- Willow-Alder- (birch). High shrub cover, low tree cover, low % horsetail (some sedge, scattered skunk cabbage)

Swamps are the most common class of "lentic" wetland in the project area and found at a range of elevations. Most are small (less than 5 hectares) with a few exceptions, but most appear biologically productive, even those beside Highway 31. Many of the larger, mid and high elevation swamps are formed by beavers and include deep pond systems as part of.

Marshes
Four main subclasses:

- Sedge-horsetail mixed with rich diversity of other plant species
- Cattail (Typha) with low % other plant species
- Bulrush (Scirpus microcarpus) with low % other plant species

Most marsh wetland development in the project area is in small patches, or fringes, on the edges of other wetland types or water bodies, with a few 12 to 20 hectare exceptions.

Deep beaver ponds
Distinct deep pond systems with classic beaver lodges are surprisingly uncommon considering that beavers are residents of most water bodies in the project area. There are numerous shallower and/or annually flooded ponds on backchannels and side channels, however, and beavers are present in most swamps in the project area. Beaver ponds provide rare and often critical

opportunities for wildlife by providing deeper water, (important for overwintering), more stable water levels, and increased in marsh wetland development.

Bogs
Only one major bog is known to exist in the project area, W19, just north of the Village of Trout Lake. This is a classic bog supporting sphagnum moss, scattered spruce and birch, and several species of flowering plants not found elsewhere. These include Calypso calceolos, (see front cover), an unidentified species of Dodecatheon (see photo in Appendix A), as well as a diversity of slightly more common wetland specialists such as buckbean, Menyanthes t.) , and cotton-grass (Eriophorum a.).

Anthro-modified marshes and swamps
A number of swampy/marshy areas with variable hydrological regimes exist that have been modified by human activities such as grazing, timber harvesting, or draining; usually a combination of all three. They differ in having a higher percentage of nonnative weedy species and usually a lower diversity of wetland species and a simpler structure.

Old Growth

See OG, OG/OM and OM/OG symbols on Maps 1, 2, and 3, and Table 3 for locations of individual stands along the valley bottom and lower slopes.

Old growth stands with "exceptional" attributes[6] are rare in the Lardeau-Beaton watershed. Only two stands examined met these structural criteria in the strict sense, OG #30, and #OG# 17. Most mature and older ("highgraded") stands along the valley bottom possess some attributes of old growth, however, and most of these sites have high site potential for supporting exceptional old growth in the relatively near future. OG/OM or OM/OG symbols on forest polygons on Maps 1, 2, and 3 symbolize stands with at least some old growth qualities. .

Mid and upper slopes old growth stands meeting a pared-down version of the "exceptional " description - that is, meeting most of same criteria, but smaller tree bole sizes - are less rare, at least in the northern two subunits of the project area, though they tend to be in a fragmented condition at least in the ICH. These stands show as age class 8 and 9 themed stands on Maps 1 to 3. They are typically western hemlock western red cedar mixtures in the ICH and subalpine fir-spruce mixtures in the ESSF.

There are small scattered locations off the main valley floor that support exceptionally large trees and exceptional old growth (not mapped in this project); these tend to be seepage sites on benches, or narrow riparian/toe-slope zones along creeks. Throughout the region, these sites appear to have been disproportionately impacted by road-building and timber harvesting (Herbison 1994, 1997).

An assessment of old growth at mid and high elevations in the Lardeau River watershed was beyond the scope of this contract; however, information on this subject has been collated and analysed as part of a number of other initiatives to which the reader can refer. These include but

[6] > 300 yrs old, >100 cm dbh common, some ~200 cm dbh, high stand structural diversity (all levels), high age and decay class diversity, high lichen, bryophyte and fungus diversity,

are not limited to: Niblett and Anderson 2006, Holt and McKillop 2006, Herbison 1994, 1997, and 2008, Hamilton and Wilson 2002, and SARCO 2007.

Travel Focal Zones

See T symbols on Maps 1, 2, and 3 and Table 4

The project identified a number of field-confirmed travel focal zones, i.e., locations where travel activity by at least some species of large and medium-sized mammals appears to be concentrated. These are shown as T's with red lines on Maps 1, 2, and 3, and are described in Table 4. There are also a number of hypothetical travel focal zones identified (yellow lines) that await field confirmation.

North of Trout Lake, several cross-valley (east-west) travel focal zones are suggested by sighting occurrences (Seaton, pers.com. Trout Lake Store owner, pers.com., tracks observed by the present project, and mountain caribou inventory work (Hamilton et al 2002). These are shown on Map 3.

Around Trout Lake itself, most north-south travel by large mammals is believed to occur along the west shore of the lake (based on author observation 1997, and Poole et al 2002). The lake itself, and the ice the on the lake, appears to be crossed readily by mammals, including several reports of same by mountain caribou (Gates pers.com. Brenton pers.com., author observation)

Along the Lardeau River, virtually all alluvial reaches of the riparian zone were found to be heavily used for travel by a variety of mammals. At constrained sections of the river channel, riparian routes tend to connect to upland routes where topography and other factors are favourable. *Mature forest stands that lie between alluvial travel zones and Hwy 3a appear to be serving an important role as visual and sound buffers for these riparian travel zones.*

At the far south end of the study area, the Lardeau-Duncan flats, travel by mammals is influenced by highways, settlement, and industrial (sawmill locations). The floodplain is much broader, less constrained by topography. Travel focal zones tend to be located along forested and brushy riparian zones and throughout alluvial island complexes that are visually buffered from the highway or other roads. There are identifiable travel focal zones connecting the riparian zone with uplands and creek drainages to both east and west near the south end of the Duncan – Lardeau flats, some of which are identified in Table 4/Map 1.

It is understood that the identified travel focal zones on Maps 1, 2, and 3 are not the "only" travel routes in the project area, (there are others) nor are all or any of them 'permanent'.

The Lardeau River corridor is commonly believed to serve an important landscape connectivity function for large mammals of all species between the two major protected areas in the region, the Goat Range Park and the Purcell Conservancy. The findings of the present project generally support that hypothesis.

KEY ECOLOGICAL PROCESSES

As discussed, it would be beyond the scope of this project to undertake a thorough review of all the ecological processes that shape habitat in the study area. A cursory list could be said to include:

- Fluvial dynamics along the Lardeau river and side creeks (flooding, erosion, deposition)
- Annual snowmelt/groundwater dynamics affecting in lentic wetlands
- Insect infestation and plant diseases
- Blowdown and breakage events , small and large, from strong winds
- Ecological succession / plant competition/ patch dynamics
- Nutrient cycling (several levels)
- Animal competition (intra and inter specific)
- Animal feeding and other uses (for example, beaver works)
- Adaptation

Many of these are interrelated. While this is obviously a complex subject, a better understanding of the role played by some of the key ecological processes in shaping habitats is likely to become increasingly germane over the coming decades.

LAND OWNERSHIP, MANAGEMENT AND THREAT STATUS

Most of the land area in the Lardeau-Duncan-Beaton watershed is Crown – owned, under a variety of management and/or use tenures, as shown on Figure 1. There are private holdings (and broad valley –bottoms) concentrated in the north and south ends of the project area: the Trout Lake flats (Map 1) and Lardeau-Duncan flats (Map 3). As is the case throughout the West Kootenays, private land is located in the richest wildlife habitat areas, the main lake and river valley bottoms, these being the only sites in the landscape suitable for year-round human habitation.

Crown land Protected areas in the project area include the Goat Range Provincial Park, the bottom edge of the Purcell Wilderness Conservancy, and a proposed protected area along the Lardeau River termed “Goal 2” (KBHLP 2002). These are shown on Maps 1, 2, and 3. The remaining Crown lands are managed/ utilized largely through forestry and recreation tenures with accompanying procedures and regulations set by provincial and regional governments. Forestry activities are regulated through the Forest and Range Practices Act (FRPA). Recreation tenures are managed though Land and Water BC. Recent higher level plans that have had a significant influence on the study area include the Kootenay – Boundary High Level Plan (KBHLP 200, 2004) and currently a draft Government Area Regulation order (in development) that addresses habitat for the Central Selkirk mountain caribou developed by the Species at Risk office (SARCO. Mining activities are regulated to some extent through the Mines Act and MOE pollution control and through companies own commitments to monitoring (as in Roca Mines near Trout Lake). There is little to nil government regulation over habitat or wildlife on private lands although in extreme cases the federal Species At Risk Act might be applied. Depending on details developed in Official Community Plans, there may in future be some RDCK regulation of riparian development on private land.

Looking very briefly at current and obvious threats to both private and crown land in the project area the following list emerges. Again, this is just a cursory review limited by project scope.

Threat or Impact	**Ecosystems affected, Potential Mitigation**
Invasive non-native Plants	Rare sites (e.g. wetlands, rock outcrops) *Inventory, pull, cut, biocontrol*
Residential expansion	Lower slopes (winter range) *Education: values, practises* *Land purchasing*
Filling, draining, rip-rap	Wetlands along Highway 31 *Education, technology*
Timber harvesting and associated roads	Mid elevation forests and some river riparian sites. *Regulation, education, incentives*
Recreational activities (ATV's)	Alpine, subalpine. Main valley lakes, Shorelines *Regulation, education*
Climate change	Alpine, wetlands *Inventory, monitor, adaptive management*
Hydroelectric projects (past)	Valley-bottoms, wetlands *Adaptive management*
Hydroelectric projects (proposed future)	Side creek drainages *Not known*
Mining and mineral Exploration	Alpine heather and herb/flower meadows *Regulation, monitor, education*

DISCUSSION

Throughout the study area, wetlands emerge as the most threatened habitat, the least well-protected, and the highest - priority habitat class for conservation attention. Less than 1/3 of the wetlands in the study area are formally protected (including all Crown parks and Wildlife Properties), and of these an even smaller percentage are actually protected, as they are affected by adjacent human influences (road maintenance, agriculture, etc).

Old growth and old-mature stands on Crown lands along the Lardeau River riparian zone/lower slopes are protected to some extent by the proposed Goal 2 protected area[7] and the Goat Range Park (GRP). (See GRP boundaries on Maps 1, 2, and 3.)

Notably *un*protected old-growth and old-mature stands include four on private land north of Trout Lake that are priorities for acquisition. One is structurally exceptional (OG 30) and the others have potential to be exceptional and serve cross-valley connectivity functions (OM29, OG/OM40, and OM41).

Old growth stands at mid and high elevations in the study area are partially protected by the BC government mountain caribou initiative (SARCO 2008). The geographic area affected, and management guidelines, can be viewed on the SARCO website: ilmbwww.gov.bc.ca/sarco/mc/index.html

Travel focal zones along the Lardeau River riparian zone north of Gold Hill will be similarly well-protected by the Goal 2 protected area and the Goat Range Park (GRP). Mid slope and upland continuations of these routes have no protection, however, except where they lie within the Goat Range Park or SARCO caribou linework. Around Trout Lake, on both west and east sides, some protection of travel connectivity is likely to be afforded through SARCO caribou mapping. North of Trout Lake, cross-valley and riparian travel focal zones are potentially threatened, a situation likely to escalate within the next decade: two of these lie within proposed residential expansion zones in the Trout Lake Official Community Plan (OCP) and may have importance to red and blue-listed large mammals such as mountain caribou and grizzly bears.

It is evident that short-term geographic priorities for conservation are the far north and south ends of the project area, the Trout Lake flats, and the Duncan-Lardeau flats. The Trout Lake flats is notable for its wetlands, cross-valley travel connectivity for wildlife, and exceptional old growth. This area is almost entirely privately-owned and includes *no formally protected lands*. The Duncan-Lardeau flats, known for its uniquely rich valley bottom habitat, critical winter range and importance for waterfowl/amphibians includes around 600 hectares of formally protected property for wildlife, the Duncan Lardeau Wildlife Properties[8] , yet the issues and threats to habitat are many due to human pressures on the limited valley bottom land base. Portions of this area will be affected by Regional District community planning processes but no Official Community Plans yet exist.

Near the end of the project, after applying the relative rarity and relative threat criteria, it became clear that alpine habitats also need attention. Alpine impacts are less directly linked to the mandate of the FWCP, however, ('to compensate for losses due to hydroelectric dams'), so they are not a focus of recommendations.

[7] "Goal 2" is still not legislated, however. Line work could use minor alterations to protect OG and OG/OM stands on or near valley bottom

[8] See Figure 1

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

General recommendations

Looking at the richest, most rare, key habitats in the project area and the most imminent threats, this report concludes that general priorities for the area as a whole should include
(1) Wetlands / riparian zones and adjacent areas. Many of the most threatened species are associated with these sensitive habitats that are also the focus of increasing human development,

(2) Connectivity. This is another value that is some jeopardy, as defined for some wildlife species, as human development increases in valley bottom/lower slope areas and recreational use increases at mid and high elevations ,

(3) Old forest structures. Any riparian and lower slope forests that include trees over 50 cm dbh and getting larger , especially where trees now over 100 cm dbh, are rare habitats if viewed from a landscape or regional context. They should be formally recognized as such in whatever manner is appropriate to land ownership status.

Recommended projects and initiatives

The following four general categories of projects emerge as contributing to the above priorities and to the general objective of maintaining / enhancing biological diversity

1. Private land habitat acquisition and protection of crown-owned surveyed lots

Purchase of private land is an essential, high-priority part of any conservation strategy in this region, since most of the richest valley bottomland - unique in landscape and critical for wildlife - is privately owned. There is some urgency, as the window of opportunity for land purchasing / habitat protection in these areas could close in the next 5-10 years as development pressure increases.

There are numerous, large (160 acre+) crown-owned surveyed lots along the Lardeau River that include virtually all the lower slopes and the valley bottom area that is not occupied by private land. Many of these have high wildlife values, as can be noted on Maps 1, 2, and 3. Some of them are protected under proposed “Goal 2”, and some lie within the Goat Range Park, but others with high habitat importance should be “flagged” for some form of special management recognition.

2. Habitat stewardship on private lands

Stewarding habitat, and in some cases wildlife, (monitoring, enhancing, protecting) on privately – owned lands will increasingly be required if species dependent on lowland habitats are to survive through predicted increase in human settlement, climate change, and other impacts. There is a need to develop sustainable systems, broadly applicable, for monitoring species and habitats in and around private lands. There is a need to provide interested landowners with the information necessary to manage their land with consideration for wildlife (‘best management practises’)

3. "Hands-on" actions on Crown lands
In some locations there is a need for direct actions, such as pulling invasive weeds, or installation of beaver-friendly culverts.

4. Inventory, monitoring, and research
Now perhaps more than ever before, there is a need for inventory and monitoring of populations and research into species ecology (e.g., relationship to environment/other species, limiting factors,), to prepare for the possibility of trying to assist species and ecosystems adapt to climate change and other major impacts.

Recommended initiatives and projects for 2008 -2010.

A number of potential projects emerged from the results of this project. These are listed in tabular form in the following pages, prioritized *within category*. It is recommended that a multifaceted approach be taken in the Lardeau -Duncan-Beaton area, undertaking projects from one or more of each category concurrently, over the next few years.

Table 8. Recommended project priorities for 2008-2010

A. Habitat Acquisition.

Project	Comments - next steps
1. Purchase District Lots 12899 and 7491 (Marlow property), Staubert Lake.	Continue negotiations. Consider variations on fee- simple purchase (e.g., retaining interest for present owner and/or relative) if that would expedite the process and lower the price.
2. Purchase all or interest in District Lots 7462 and 7828 (Wasden property), Duncan-Lardeau Flats.	Contact landowner to explore possible alternatives to outright purchase, if purchase appears complicated at this time Provide some form of incentive; spark interest.
3. Purchase or otherwise protect the portion of District Lot 769 that is occupied by a rare bog, (W#19) Trout Lake flats.	Confirm land ownership status and status in the OCP; contact owner and/or RDCK planners and OCP Advisory Committee.
4. District Lots 7795 and 770 old growth values and OG/OM cross-valley travel focal zone, Trout Lake flats	Look into potential for purchase or other form of protection.
5. S.A.R surveys. "Presence-not-detected "and reconnaissance surveys on lots listed above and adjacent properties.	Precede surveys with a summary of available information including anecdotal records.

B. Habitat Stewardship on Private Lands

Project	Comments – Next Steps
1. Provide mapped wildlife information to landowners, communities, RDCK planners *If this project were undertaken in 2008-2010, it could be part of the OCP planning process for 6 communities in area D, at the south end of the study area.*	A gap not being filled by any other agency. Communicate with Regional District planners and local planning committees where OCP planning is in process, and where communities have previously expressed interest in this information. Mapping/communication would focus first on connectivity/travel functions that need to be addressed beyond individual lot boundaries. Eventually, additional lot-specific information could identify sensitive /rare/key habitats for interested landowners. 1:5,000 maps would be presented in the context of 1 20, 000 maps showing surroundings.
2. Produce guides to "Best practises" for landowners (especially new landowners) in rural or interface areas to minimize ecological footprint and reduce human-wildlife conflicts ("Beyond bear smart")	Produce pamphlets illustrating ideas for best practices for agricultural endeavours, slash-burning, firewood-cutting, fencing, dog management, cat management, driving alongside riparian zones and more. Design so it can be continually revised with new findings and inventions.
3. Communicate with interested landowners re: options for stewardship, gifting, economic and legal benefits associated with habitat preservation, active enhancement, co-ownership, or conservation covenants	Provide concise written summaries of the existing legal situation, and options. Offer technical advice and possibly assistance to interested property owners. Initiate contact with owners of the highest -value habitat properties, (see Table 7), to invite their participation.

C. 'Hands-on' actions on Crown Lands and Wildlife Properties	
Project	**Comments – Next Steps**
1. Clemson leveller #1. Install in upper beaver dam adjacent to newly acquired Nature Trust property, at the upper end of Argenta Slough	See plans for Clemson leveller, attached, believed to be the best solution to the ongoing beaver – painted turtle – water level management problems in this location. Contact DU in B.C., for adaptations to the U.S. plans. This project needs to be co-ordinated with other hydrological considerations on the system, e.g. the Boyd/Lake irrigation ditch that brings water from Hamill Creek.
2. Clemson leveller # 2. Wetland # 9, Lardeau River	As part of communication with BC Parks and Highways, utilize this project and others to reduce impact on wetlands along Highway 31 while still meeting needs of road maintenance.
3. **Argenta Painted turtle nest sites**: enhance additional sites with sand/gravel. Remove some of shade sources from existing and new sites. Replenish gravel at existing site.	There is a site beside the "Wasden causeway" where turtles have attempted to nest, to date unsuccessfully, that could be improved greatly for nesting by a few loads of gravel. Part of this is private land, part of it is road allowance. Need to communicate with affected landowner D.Wasden and Highways. Also, look at the possibility of creating potential nesting habitat on private land bordering north end of slough near newly acquired Nature Trust property.
4. Invasive non-native plants: control and monitor while infestations are still minor	Look into collaboration with other funding agencies to establish an ongoing effort throughout the Lardeau-Beaton area, possibly an annual summer youth crew, to both track and directly control weed infestations in a prioritized, strategically effective manner.
5. Roadside Wildlife Habitats: **Best Management Practices** for Road and Highway Planners and Maintenance Crews"	Provide written and possibly illustrated manual to Highways maintenance crews and area supervisors providing time windows and other management information useful for protecting turtle nests, wetlands, travel focal zones and other wildlife values that intersect roads. Precede this with amicable discussions. Need to contact BC Parks about values along Highway 31.
6. Protect selected black Cottonwood trees from beaver-chewing	Identify locations where this is needed, namely, where CT trees constitute unique habitat features, where there is no recruitment probable in near future, and where there is intensive beaver activity. Plan to use simple system of chicken-wire held out from tree trunk with wooden spacers.
6. Enhancement of caribou early winter habitat readiness and travel suitability through thinning and inoculation?	Assess the feasibility, likely effectiveness, and desirability of thinning and inoculating some of the dense young plantations in historically very productive caribou early winter habitat that now lies largely within Goat Range Park on the west side of the Lardeau River between Rapid Creek and Mobbs Creek. This area includes several potential travel zones for caribou, e.g., T-8, Map 2.
7. Travel focal zones: address in locations where need for protection or special management is imminent.	Provide map of known travel focal zones on Crown land to agencies that should have them, as appropriate, in the interest of protection. Include general guidelines for protection. Could include MOE, ILMB, MOF, or forest or recreation licensees. Consider the sensitive/confidential nature of this information.

8.. Woodlot habitats: Rare swamp W#5 and travel focal zones 4a,4b, Howser Ridge	Assess current conditions and communicate with B. Sinclaire to provide information about these habitats in a non-threatening manner. The information itself is expected to contribute to protection, in this case. Evolve special management guidance based on woodlot owner interest.
9. Restoration in Deception-Greyhorse wetlands and future old growth cedar	Assess on-the-ground feasibility and potential for planting deciduous trees, shrubs, red cedar and other actions to enhance biodiversity in this very extensive, rich, wetland/mixed habitat area that once supported exceptional old growth . Located partially in the Lake woodlot license and partially in Meadow Creek Cedar' license area. Both licensees are likely to be supportive of such a project.

D. Planning, Inventory, Research, Monitoring

Project	Comments – Next Steps
1. "Goal 2" Proposed Protected Area: Legislation and boundary refinement	Obtain update from Parks regarding Goal 2 status, and discuss boundary details. Ensure the boundaries include the important riparian old-growth and near old-growth stands identified in this report[9].
2. Data gaps for Species at Risk (SAR): plants and animals**.** (E.g., molluscs , dragonflies, plants)	Design a strategy to prioritize and address data gaps for federally and provincially listed 'at risk" plants and animals. Include molluscs and dragonflies. Some data gaps are noted in Table 1.
3. Status of local reptile and amphibian populations	Identify critical habitat sites for herptiles (in addition to the wetlands mapped in present project), e.g. talus habitats known to be important for snakes and lizards. In representative sites establish baseline numbers against which to compare future counts, for detecting population trends. Related to projects 4 and 5 below.
4. Crown-owned surveyed lots with high habitat value: special management systems?	Confirm ownership status of all lots listed in Table 6. These are Crown-surveyed lots with high habitat values that are not (yet) privately-owned. Most lie within forest licensee operating areas. Communicate with relevant agencies regarding wildlife values, potential for special management plans, and long term status.
5. Sustainable monitoring systems. Develop self-sustainable, long-term wildlife/ecosystem monitoring systems.	There is a need to develop long-term wildlife and habitat monitoring systems, using consistent methods that are sustainable in sparsely populated areas. This may mean income-generating in some way (tourist monitors?) or it may mean using students on a regular basis in some way , or…. it may mean utilizing creative technological approaches such as motion-sensitive cameras, sound recorders, etc
6. Rare and special habitats. Continue with inventory.	Most rare and special habitats are discovered coincidentally during the course of other activities, or during the course of studying or inventorying an animal or plant species. Ideally these should be mapped and catalogued as they are discovered but this does not normally occur. Rock outcrop and talus habitat mapping could easily be refined with air photos.

[9] A riparian portion of OG/OM #3 was harvested in early 2008. Not clear if within the Goal 2 line-work.

D. Planning, Inventory, Research, Monitoring, cont'd	
7. Key ecological processes. Define key ecological processes that shape habitat quality, quantity, and distribution.	Break down and elaborate on key processes and their actions and effects on specific habitat types. First address habitat types that presently constitute management " problems"
7. Conditions for connectivity: Define specific connectivity requirements for large, wide-ranging mammals throughout the Lardeau River corridor.	Focal species recommended for initial efforts are red-listed mountain caribou, blue-listed grizzly bear, and western toad (a species 'of special concern').
8. Anthropogenic history of wetlands with a view to potential restoration	Look at past practices such as grazing, logging, or draining and how they have created present conditions; consider whether rehabilitation is appropriate, and if so what.
9. Mineral use by ungulates and small herbivores: improve understanding of requirements, sources . Look at improving ability to predict locations, and to enhance.	Test location predictions [based on geological info, air photo interpretation, wildlife sighting data], by field checks Assess potential for enhancement through exposure.
10. Sensitive Ecosystem Mapping	Translate present project to the standardized SEM format (Venus database). The mapping methodology, criteria, and intent, are similar to the (RISC) standard Sensitive Ecosystem Mapping (SEM) but the data entry format and terminology differs.
11. Mountain caribou, Central Selkirk herd. Calving and post-calving habitat selection and mortality factors	This is recognized to be a difficult subject to research but it is nevertheless significant knowledge gap for this herd

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