UNGULATE WINTER RANGE SPECIES ACCOUNTS SPECIFIC TO THE PEACE RIVER REGION 2003

Prepared By:

Alicia D. Goddard
Woods Environmental Consulting
SS#2 Site 13 Comp 17
Fort St. John, BC
V1J 4M7

For:

Ministry Water, Land and Air Protection
Ecosystem Section
Rm. 400-10003-110 Avenue
Fort St. John, BC
V1J 6M7

March 2003

EXECUTIVE SUMMARY

The purpose of this project was to collect and describe winter habitat use for ungulates within the Peace region. Literature and annecdotal information was collected from local biologists and species experts in an attempt to develop stand-alone species accounts for ungulates in the Peace region.

In gathering habitat use information, it was determined that the primary source of information pertaining to habitat use is derived from provincial species standards. For many species, these provincial species accounts do not apply to animals and their habitat use within the Peace region. This report outlines how habitat use is different from provincial standards, and describes habitat use specific to the Peace region.

Very little reliable, accurate scientific data is available for ungulate winter habitat use in the Peace region. Although numerous projects are currently proceeding, more research projects need to be initiated to produce specific, reliable scienctific data pertaining to winter habitat use by ungulates in the Peace region.

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

The purpose of this report is to describe critical winter range attributes of ungulate species, specific to the Peace River region of northeastern British Columbia. The following species accounts will focus on the specific habitat requirements of ungulates within the Peace River region. Therefore, this report should not be considered a proper species account, but rather an overview of specific requirements for winter range within the Peace River region. Due to a shortage of reliable research and available scientific data, much of the information gathered was obtained through personal communications with local biologists and species experts. An extensive literature review of past and present research conducted within the area was also completed to build a database of habitat use specific to the Peace region. A number of projects using GPS technology have begun within the Peace region. Many of these projects are early in the process, and have yet to report data findings. These projects will be discussed throughout the following species accounts and further outlined in Section 3.0.

The Peace River region is a large region encompassing many different landscapes, vegetation types and geographical variants. Because of the great diversity and range of habitats within the region, specifying species requirements is a difficult task. Primarily, the Peace region is a very distinct geographical region of the province, and thus ungulates within the region have distinct requirements and habitat needs. This is especially prevalent within the winter season, where snow depths and winter conditions do not match those described for other areas of the province. Because of these factors, there is a growing need for specific information pertaining to species habitat requirements in the Peace River region, and its many varying habitat types.

Eight ungulate species will be included in this report: mule deer, white-tailed deer, moose, Rocky Mountain elk, Stone's sheep, mountain goat, woodland caribou and bison. Bighorn sheep have not been included in this synthesis as they occur only intermittently in the most southern portions of the region (Backmeyer, pers. comm.).

2.0 SPECIES ACCOUNTS

The following species accounts have been described specific to habitat use within the Peace region. In some cases, habitat use by one species differs within different areas of the region. This has been indicated, and the species descriptions have been broken into these geographical groups accordingly. Emphasis has been placed on aspect, slope and elevation habitat variables, for the purpose of digital elevation modeling and identification of future ungulate winter range areas within the Peace River region.

2.1 Moose

Moose use of habitat throughout the Peace region is fairly uniform, showing no distinct changes between different geographical areas (Backmeyer, pers. comm.). The provincial species account for moose habitat is widely applicable for moose in the Peace region. The general winter habitat used by moose within the Peace region can be described as early- to mid-seral stage, with an abundance of available browse species in low to mid-elevations (Churchill, pers. comm., Goulet and Haddow, 1985). Preferred areas include riparian and alluvial habitats, burns, cut blocks and wetland complexes (Churchill, pers. comm.). However, because of the uniformity of moose habitat within the Peace region, moose tend to use any habitat that provides available forage (Webster, pers. comm., Woods, pers. comm.). Depending on the area, moose can be observed wintering from valley bottoms to the subalpine. The probable characteristic shared by each of these habitats, or replicated (as in the subalpine habitats), is the early to mid-seral stage exhibited by the habitats.

Seasonal migrations, from summer to winter ranges are not similar throughout the Peace region. Elliot (pers. comm.) describes that seasonal migrations of moose are dependent primarily on the distance from mountainous terrain. Moose in the Peace Lowlands ecosection do not show seasonal migrations, as the distance to mountainous areas is too great, abundant forage is readily available and snow depths are generally not limiting in the area (Elliot, pers. comm.). Primarily, moose will winter where there is an abundant supply of forage available (Elliot, pers. comm.). Moose located in areas closer to the mountains or in foothill regions do show some migration between summer and winter ranges. Moose may summer in higher elevations, and depending on snow conditions through the winter, may remain in high elevation habitats or move down to low elevation habitats for winter months (Elliot, pers. comm.). Terrestrial Ecosystem Mapping (TEM) projects in the Snake/Sahtaneh (TerraMar Environmental Research, 1999) and La Biche and Sandy Creek (Teversham et al., 1998) areas describe elevational migrations of moose in these areas to be absent. The lack of elevational migrations can be likely attributed to fairly flat terrain and uniform snow depths throughout the area (Teversham et al., 1998).

Snow depths are suggested to be the determining factor to whether moose will make elevational movements (Silver, 1976). Thus, the use of varying elevation and snow depth restrictions can be discussed together. Churchill (pers. comm.) describes moose to be highly variable in their selection of winter habitat based on elevation. Moose can do well in areas below 900 m and above 1350 m (Churchill, pers. comm.). However, the range of 900 to 1350 m can be restrictive to moose and provide poor wintering areas because of the snow depths in this snowbelt range (Churchill, pers. comm.).

The use of elevation appears to be highly variable throughout the region, depending on which area is being considered. The following incorporates a number of studies completed within the Peace region that discuss the varying uses of elevation throughout different areas of the region.

- Silver (1976) studied moose winter habitat use in the upper Cameron River and Halfway River area. In this region, the elevation at which moose would winter was largely determined by the severity of the winter. During mild winters, moose were observed at

altitudes of 1525 m and greater, but during severe winters, moose were observed in low elevation valley bottoms (Silver, 1976).

- A TEM project in the Smith/Vents River area reported very little use of higher elevations (Norecol Dames and Moore Ltd., 1998). Observed wintering areas within the Smith/Vents River area were at elevations of 760 m or lower, with some use of drainages on the east side of Smith River at elevations of 760-900 m (Norecol Dames and Moore, 1998).
- A study conducted in the Williston Reservoir area showed that moose used high elevations until snow depths became limiting, forcing the animals to lower elevation valley bottoms (Hatler, 1989). Hatler (1989) suggests high snow accumulation impedes both mobility and forage availability. The use of higher elevations in the Williston Reservoir area is reportedly due to the loss of riparian flats and valleys when the reservoir was created, forcing moose to utilize higher elevation habitats (Culling, pers. comm., Silver, 1976).
- Luckhurst (1973) studied sheep-vegetation interactions within the Nevis Creek area, and reported sightings of moose commonly using habitats above treeline, feeding primarily on shrubs that crested the snow levels.
- Aerial surveys conducted in the Mount Bickford area reported moose to use high elevation, alpine and subalpine habitats up to late November (TERA, 1995a). After this time, however, moose would begin moving down to lower elevation winter habitats. TERA (1995a) report that the majority of moose observations were made between elevations of 800 to 1500 meters asl.
- Moose observations made in areas south of the Peace Arm reported that significant moose activity was only observed in lower elevations (below 950 m) (Backmeyer, 1991). Moose were more abundant in eastern portions of this study area, and observations of moose use decreased with westward movement towards the reservoir (Backmeyer, 1991). A small number of moose were observed in the Clearwater River valley, but it is believed that in areas west of the Clearwater River, snow accumulations are greater, and wintering areas are not suitable as compared to areas further east (Backemeyer, 1991). Under mild winter conditions, valley bottoms in the western portion of the South Peace Arm may provide moose winter range, but under normal to severe winter conditions, snow accumulations would restrict moose use of these areas (Backmeyer, 1991).
- Moose observations in the Akie/Pesika River drainages reported the mean elevation of all moose sightings in the area was less than 980 m (Hatler, 1990).
- In the 2002-2003 winter, Culling (pers. comm.) reported moose in the Graham River area to be wintering at much higher elevations than observed in previous years. Culling (pers. comm.) describes this to be due to low snow accumulations on the slopes until late in the winter. Moose were observed at treeline this year, while normally at this time they are located in lower elevation, forested habitats, due to the snow accumulations at higher elevations (Culling, pers. comm.).
- Within the Burnt River area, aerial surveys for moose showed the highest track count densities were observed in low elevations (between 800 and 1550 m), showing track densities to decrease with increasing elevation (Westworth Associates Environmental Ltd., 1998).

The biogeoclimatic zone classification (BGC) has been used in some studies to assess whether an area is capable of supporting winter range for a species. Several studies conducted in the Peace region report findings on BGC zones that were avoided or selected by moose, or include observations of moose within selected BGC zones. Within the Burnt River area, SBSwk2 and BWBSmw1 were preferred habitats, while ESSFwk2 was avoided and ESSFmv2 was neither avoided nor preferred (Westworth Associates Environmental Ltd., 1998). The majority of moose activity was concentrated in the northeastern part of the Burnt River study area, which was the only area dominated by BWBS and SBS zones (Westworth Associates Environmental Ltd., 1998). Within the Besa/Prophet River TEM study area, moose were observed in all biogeoclimatic zones; however, significantly lower use was observed in the SWB zone (R.A. Sims and Associates, 1999). Churchill (pers. comm.) suggests that the ESSF zone provides poor moose habitat because of the greater snow depths in these areas. The BWBS provides excellent moose winter habitat because of the available forage quality (Churchill, pers. comm.). This comment is supported by Silver (1976), who reports that 80% of moose observations were in habitats representative of the BWBS zone.

The structural stage of a habitat may also contribute to habitat selection by moose. Structural stage has been a focus by many TEM projects, in describing an ecosystem and its attributes for ungulate winter range. Primarily, the structural stage most important to moose is one that provides abundant forage (Goulet and Haddow, 1985). This is generally provided within the early seral stages of forest succession. Within the Burnt River area, moose were observed in, but showed no preference for, structural stages 3, 5 and 6 (Westworth Associates Environmental Ltd., 1998). Structural stages 3 through 6 are described as shrub/herb, pole sapling, young forest and mature forest communities, each providing valuable vegetation components important to moose forage and cover (RIC, 1998). Track counts revealed structural stages 3a and 4 to be preferred by moose in the Burnt River area (Westworth Associates Environmental Ltd., 1998).

Slope and aspect may also be determining factors in winter habitat selection by moose. Unlike many other ungulate species, moose are not as dependent on south-facing aspects as a component of winter range. In some areas, south-facing slopes may provide abundant forage opportunities in the form of shrubs and deciduous browse, and these areas may be important because of the forage quality. However, these areas must be considered distinct from other south aspect slopes that are commonly identified as ungulate winter range for elk. South aspect winter ranges classified for elk are not as suitable for moose because of the difference in forage requirements by each species. Moose are also able to move through deep snow with greater ease than mule deer, sheep or caribou; therefore, the requirement for south aspects as a means to minimize snow depths is not as critical. Silver (1976) reports that within the Cameron River area, 89% of moose used east and west slopes during early winter, with a large increase in use of west and south aspects during late winter. Aspect is important to moose habitat, if the vegetation and productivity of the site meets moose requirements. Churchill (pers. comm.) describes the driving factor behind moose habitat selection is probably high productivity. Therefore, aspect should be considered if the area also meets moose forage productivity requirements, but an area should not be protected for aspect alone. In areas on the west side of the Rocky Mountains, moose have been observed using south aspect slopes in the Akie River, Ospika River, McCusker Creek and Ingenika River drainages (Hatler, 1990; Backmeyer, 1991). It is unknown, however, whether the use of these south aspects was selection for the aspect or use of burns along the

south aspect slopes. Hirst (1990) also reports use of south aspects by moose in areas along the north shore of Peace Arm. Within the Besa-Prophet River area, moose use of north aspect slopes was limited, recording much lower track densities (R.A. Sims and Associates, 1999). Goulet and Haddow (1985) report moose in the Liard River valley used south and southeast aspects, with little to 40% slope.

Moose observed in both the Burnt River area and in the Cameron River area used primarily low percent slopes (Silver, 1976; Westworth Associates Environmental, 1998). Silver (1976) reports a high use of flat terrain and U-shaped valleys by moose in late winter, and in general moose within the Cameron River area preferred flat areas and moderate slopes. This finding is supported by observations of moose in the Burnt River area (Westworth Associates Environmental Ltd., 1998), where moose preferred slopes less than 6% and slopes between 11 and 20%, and in the Besa-Prophet River area (R.A. Sims and Associates, 1999), where moose track densities were significantly lower in areas of steep slopes. These findings also correspond with habitat types preferred by moose, such as alluvial areas, wetlands, riparian flats and valley bottoms (Goulet and Haddow, 1985; Hatler, 1989; Hatler, 1990; Backmeyer, 1991; Norecol Dames and Moore, 1998; Churchill, pers. comm.).

Vegetation utilized by moose may be an important factor in determining winter habitat use. Within the Peace region, it has been suggested that the driving factor behind winter habitat selection by moose is the productivity and availability of forage (Churchill, pers. comm., Elliot, pers. comm.). Important forage species for moose can be generally described as deciduous browse, specifically red-osier dogwood (*Cornus stolonifera*), willow (*Salix* spp.), aspen (*Populus tremuloides*) and birch (*Betula glandulosa* var. *glandulifera*) (Silver, 1976). Red-osier dogwood is a high productivity food that is often selected for by moose, and is an important component of moose winter diet within the Peace region (Churchill, pers. comm.; Elliot, pers. comm.).

Silver (1976) studied forage use by moose within the Cameron River area by conducting rumen analysis, trailing studies and investigating feeding craters. The diet of moose varied among seasons, with the major components of winter diet being willow and aspen (Silver, 1976). During early winter, rumen analysis reported willow to be the primary species, but also showed the presence of cow parsnip and Jacob's ladder (Silver, 1976). Late winter diets suggested by the rumen analysis show a shift to greater aspen fragments in the feces, but willow making up the majority of the volume (Silver, 1976). Trailing studies conducted reported 53% of the total winter diet was willow, with aspen and bog birch comprising 15% and 14% of the winter diet, respectively (Silver, 1976). A relationship between forage species, time of winter and snow depth was determined by the analysis. Early winter diets showed lower use of willow (37%), while late winter diets showed greater use of willow (57%). Silver (1976) suggests this can be related to snow depths, which ultimately determine the extent to which shorter plant species are covered by snow, and therefore, the shift to willow species. Debarking of aspen during late winter was also observed in the area (Silver, 1976). Cratering activities were observed in the area, but many of the craters contained species different from the ones observed in the trailing studies and rumen analysis. Bulrush, raspberries, cow parsnip, grasses (*Bromus* spp. primarily) and oats were the primary species found within moose crater sites (Silver, 1976). Many of the crater sites were located in recent land clearing areas, along disturbed roadsites and seismic lines. Silver (1976) reports the most important forage species for moose during the winter is willow.

In the Liard River valley, browse selection/avoidance was investigated for moose by investigating utilization of species and availability of species (Goulet and Haddow, 1985). Willow and red-osier dogwood were preferred or selected by moose, as they were used in greater amounts than what was available (Goulet and Haddow, 1985). Other species that were selected for by moose include mountain ash, bog birch, aspen, paper birch and highbush cranberry (Goulet and Haddow, 1985). Overall, willows accounted for greater than one third of all browse utilization within the Liard River valley study. Goulet and Haddow (1985) also investigated the use of browse as compared to availability in different habitat types. Browse use was greater than expected in subalpine and alluvial habitats, less than expected in upland deciduous, mixed and coniferous habitats, and used in proportion to availability in bog lowlands and burns. The use of browse within burns, however, was dependent on the age of the burn, with younger burns (10-12 years old) receiving greater use of browse than in older burns (20-38 years old) (Goulet and Haddow, 1985). Luckhurst (1973) reported moose feeding primarily on shrubs greater than one meter in height in the Nevis Creek area. Webster (pers. comm.) discussed a possible competition for resources between moose and bison in selected areas. This may be important with the growing expansion of bison within areas of the Peace region, in combination with urban expansion and deterioration of moose winter habitat. Bison have established a niche, pushing moose out of these areas, and possibly limiting moose winter range (Webster, pers. comm.).

Within the Peace region, and specifically the Peace Lowlands ecosection, moose are easily sustained by an abundant supply of suitable habitat that supports valuable forage for moose (Elliot, pers. comm.). Unlike deer, moose cannot be as selective in their forage selections because of their size and the amount of forage required to sustain themselves (Elliot, pers. comm.). Because moose are not as selective, they are less limited and influenced by snow depths, suggesting that moose can survive in a variety of conditions, if the forage is abundant and productive (Churchill, pers. comm., Elliot, pers. comm.).

Moose utilize a number of specific habitat types for winter range. Literature suggests that moose require habitats that support both cover and forage values (Thompson and Vukelich, 1981, cited in RIC, 1999). Cover is required during high snow times, as coniferous forests provide snow interception and thermal protection (RIC, 1999). There is current debate over the subject of whether cover is a required element of winter range habitat. Some suggest that abundant forage is the primary limiting factor, and that cover is not necessary if forage is available (Kelsall and Prescott, 1971, cited in RIC, 1999). This appears to be the case within the Peace region. Backmeyer (pers. comm.) discussed that moose will generally remain in open habitats to temperatures of -10°C. Because of their large size, dark colour and ability to withstand cooler temperatures, temperatures of -10°C may not cold enough to force moose into thermal cover (Backmeyer, pers. comm.). Within the Peace region, winters are generally clear and cold. With extended periods of sun, moose may not require thermal cover throughout the winter, because of the heating through solar radiation received by being in open areas.

Throughout most of North America, moose generally make use of coniferous habitats during winter (Teversham et al., 1998). However, Silver (1976) reports the sole use of open habitats during the winter by moose in the Cameron River area. Even under heavy snow years, moose did not move to coniferous forests, but rather remained in open habitats (Silver, 1976). Silver (1976) discusses that the sole factor affecting habitat selection is forage quality and abundance,

and protection from environmental conditions may be better yielded through topography of the area. In particular, Silver (1976) discusses the broad valley bottoms of the Halfway River and associated tributaries may provide better thermal cover and forage availability, than a coniferous forest type would in the area. The lack of coniferous use may also be attributed to lower snow depths in the region (snow depths did not exceed 76 cm), which may not be restrictive to moose (Teversham et al., 1998).

As discussed earlier, moose make wide use of early seral communities, which generally includes habitat types such as burns, cut blocks, riparian areas, wetland complexes and shrub-dominated communities. Similar to the other habitat attributes summarized, habitat types used by moose vary within the Peace region. Numerous studies describe the different habitat types and vegetation communities that moose use during the winter season. These habitat types are outlined below, grouped by different geographical areas.

- Within the Fort Nelson area, Culling (pers. comm.) reports moose to spend the summer and fall seasons in deciduous upland habitats. In the winter, moose have been observed to migrate down into lower elevation, wetland complexes, which are often used by resident boreal caribou (Culling, pers. comm.).
- Moose preferred pine, deciduous and mixedwood habitats in the Burnt River area (Westworth Associates Environmental Ltd., 1998). Early succession areas and areas of dense shrubby understory were also utilized by wintering moose (Westworth Associates Environmental Ltd., 1998).
- A TEM project in the Smith/Vents River area reported moose to be abundant in the Vents River and Fishing Creek drainages (Norecol Dames and Moore Ltd., 1998). Moose in the region were primarily associated with riparian habitats along streams and wetlands, and commonly observed in shrubby areas. This type of habitat use was also reported for the Smith River floodplain, where moose were in lower numbers, but concentrated in riparian habitats. Norecol Dames and Moore Ltd. (1998) describe the wintering areas for moose in their study area to include the riparian habitats and lower slopes of Fishing Creek and Fishing Lake. In addition, burn areas were utilized on upland slopes along Mould Creek and Teeter Creek (Norecol Dames and Moore Ltd., 1998).
- Areas in the southern Williston Reservoir region showed high moose utilization in cut blocks (61% of moose observations) (Hatler, 1989). Contrary to other reports for the Peace region, only 14% of moose were observed in the riparian and wetland habitats that are suggested as prime winter habitats (Hatler, 1989). Hatler (1989) suggests this could possibly be associated with recent changes in riparian habitat due to flooding.
- Moose in the Cameron River area consistently used areas of fire and/or seismic exploration throughout the winter, while flooded and agricultural areas had increased use during late winter (Silver, 1976). All moose observations in the Cameron River area were characterized by little coniferous cover, resulting in moose using burn areas on grassland slopes and agricultural fields (Silver, 1976). Silver (1976) reported extensive use of unnatural habitats such as agricultural fields, haystacks and oat pilings, possibly affecting the winter distribution of moose in the area. Seismic lines within the Cameron River area showed a positive relationship with moose dispersion (Silver, 1976). Silver (1976) suggests seismic lines to provide abundant edge habitat, good growing areas and a corridor for travel. Riparian areas, however, remain the most heavily utilized habitat by

moose during the winter season – especially within the Halfway River valley (Silver, 1976).

- TERA Environmental Consultants (1995b) found moose to use a combination of forested and cleared habitats in the areas south of the Peace Arm. The majority of moose observations were made in the east end of the study area, specifically along the Pine River. The most commonly used habitats were white spruce-balsam poplar riparian communities (TERA Environmental Consultants, 1995b). Moose in the area also used Engelmann spruce-subalpine fir forests.
- Within the Liard River valley, moose were widely distributed primarily in alluvial habitats (32.1%), burns (26.1%) and upland deciduous and mixedwood habitats (16.0%) (Goulet and Haddow, 1985). In the burn habitat units, moose selected deciduous regrowth areas rather than the pine regrowth. Habitats within the Liard River valley with high moose densities were characterized by dominant shrubby vegetation and low upland coniferous forests (Goulet and Haddow, 1985). Higher densities were observed in habitats that had a greater proportion of shrub/alluvial vegetative cover than areas with high upland coniferous forests (Goulet and Haddow, 1985). Moose significantly selected three habitats types within the Liard valley: subalpine deciduous shrubland (moose density of 2.99/km^2), riparian/alluvial habitats (1.23/km^2) and burn habitats (1.07/km^2) (Goulet and Haddow, 1985). Areas that were avoided (used less than availability) included upland deciduous, mixed forests and coniferous forests, while bog areas were used in proportion to their availability (Goulet and Haddow, 1985). Pellet counts revealed that areas with the best combination of forage and cover had the highest pellet densities. These areas included burns, deciduous shrubland, bog birch shrubland, open slopes and riparian edges, which had both abundant forage and mature forest cover in close proximity (Goulet and Haddow, 1985). Based on observations, pellet counts and browse utilization, subalpine, burns and alluvial habitats were significantly preferred within the Liard River valley (Goulet and Haddow, 1985).
- Moose observed in the Ospika River drainage were associated with deciduous stands and burned habitats on south-facing slopes along the Ospika Arm (Hengeveld and Corbould, 2000). Aerial surveys completed in the area report observation of moose using valleys and predominant use of forested habitats within the Ospika River drainage (Hengeveld and Corbould, 2000).
- Moose were observed using the Pesika River burn (Wood, 1994).
- The areas northeast of the Williston Reservoir showed high use of burns for moose winter habitat, and low use of cut blocks (45% and 5% of moose observations were in burns and cut blocks, respectively) (Hatler, 1990). As compared to the same study conducted in the southern Williston Reservoir area, the northeast area showed much lower use of cut blocks (5% versus 65% in the southern reservoir area), and greater use of riparian areas (Hatler, 1990).

There are several key areas within the Peace region that have been highlighted as important winter habitat for moose. These areas have been classified as important winter range areas through observations of moose use, high-density use or by habitat features considered important to moose during the winter season.

- Along the north side of the Peace Arm, Dunlevy Creek, Aylard Creek and Schooler Creek valleys provide important winter habitat based on a high number of moose observations in these areas (Hirst, 1990). Adams Creek also supports moose during the winter season (Wood, pers. comm.).
- Butler Ridge provides good moose winter range (Wood, pers. comm.).
- Within the Graham River watershed, the meadow complex and adjacent mature coniferous cover of the Meadow Creek drainage is important moose winter habitat, based on concentrations of both male and female moose wintering in the valley bottoms and along treeline (Culling and Culling, 2001).
- Habitats between the Halfway and Sikanni Chief Rivers have been identified as critical moose habitat within the Peace region (Webster, pers. comm.). Webster (pers. comm.) describes areas between Mile 95 and Mile 148, bordered by the Alaska Highway in the east and the Halfway River in the west, to be critical moose habitat. Silver (1976) also identified high use of Blair Creek, Cameron River and Halfway River valleys by moose.
- The Nevis Creek valley is important winter habitat for moose (Woods, pers. comm.).
- Riparian habitats within the Vents River, Fishing Creek and Smith River valleys had abundant moose during the winter (Norecol Dames and Moore Ltd., 1998).
- In the Liard River valley, high moose densities were observed in the following areas: (1) at the confluence of the Liard and Rancheria Rivers; (2) the Aline Lake area; (3) along the shores of the Liard River at the Hyland River and between the Vents and Deer Rivers; (4) at the confluence of the Toad and Liard Rivers; (5) the Kitsa Lake area; and (6) the Hyland River valley (Goulet and Haddow, 1985).

Discussion with local Peace region biologists yielded a number of management suggestions that should be recognized as part of local species knowledge and considered in determining moose winter range within the region. Primarily, managing for moose habitat, regardless of season, is very difficult and may not be necessary for the region (Elliot, pers. comm.; Webster, pers. comm.). The Peace region supplies an abundant source of suitable moose habitat and almost all areas within the region support valuable habitat; therefore segregating areas that are of specific importance is difficult (Elliot, pers. comm.; Webster, pers. comm.; Woods, pers. comm.). Webster (pers. comm.) suggests that it may be more effective to look at the patterns of change in the landscape over the past 30 to 40 years, to determine the rate of change in habitats and to identify which areas were historically, currently and potentially important. Elliot (pers. comm.) describes that to protect moose habitat, is to ensure there is abundant forage available. Culling (pers. comm.) reports snowmobile use is common on ridges and valleys within the Graham River watershed area. ATV closures in the areas do not include snowmobile use, and this may impose added stress to wintering ungulates in the area. Domestic livestock may compete for herbaceous and browse forage in areas of overlap (Silver, 1976). This becomes an important issue when winter range is in poor condition or with high domestic densities (Silver, 1976).

Table 1. Summary of moose winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCE	BGC ZONES	SLOPE	ASPECT	ELEVATION	COMMENTS
Misinchinka Ranges	1, 15				• High elevations used until snow depths become limiting; lower elevation valley bottoms used under limiting snow depths • Greatest moose activity lower than 950 m	Southern Williston Reservoir area
Northern Hart Ranges	1, 15				High elevations used until snow depths become limiting; lower elevation valley bottoms used under limiting snow depths	Southern Williston Reservoir
Hart Foothills	37	• SBSwk2 & BWBSmw1 were preferred • ESSFwk2 was avoided • ESSFmv2 was neither avoided or preferred	Preferred slopes less than 6%, and between 11-20%		Highest track count densities between 800-1550 m; track densities decreased with increasing elevation	Burnt River area
Peace Lowlands	45				All elevations utilized	No apparent selection for elevation
Halfway Plateau	30	80% of moose observations were in habitats representative of the BWBS zone	• Use of low percent slopes • High use of flat terrain and U-shaped valleys	• Early winter: east and west aspects • Late winter: increase in use of west and south aspects	• Mild winters: 1525 m and greater • Severe winters: valley bottoms	Cameron River area
Peace Foothills	20, 33			Use of south aspects along north	• Use of high elevation habitats until late November, after	Mount Bickford area

				shore of Peace Arm	which movement to low elevation habitats occurred • Majority of sightings between 800-1500 m	
Muskwa Foothills	22, 27	Observed in all BGC zones; lower use in the SWB zone	Track densities significantly lower in areas with steep slopes	Low use of north aspects	Commonly used habitats above treeline	Nevis Creek area; Besa-Prophet
Western Muskwa Ranges	16			South aspects	Mean elevation of moose sightings was less than 980 m	Akie/Pesika River area; Ospika, McCusker and Ingenika River drainages
Liard Plain	14, 24			Use of south and southeast aspects	Between 760-900 m east of Smith River	Smith River area; Liard River valley
Hyland Plateau	14			Use of south and southeast aspects		Liard River valley
Muskwa Uplands	14			Use of south and southeast aspects		Liard River valley
Kechika Mountains	24				760 m and lower	Vents River area

2.2 Mule Deer

Mule deer are found throughout the Peace region; however, the highest population densities largely occur within the Peace Lowlands ecosection (Backmeyer, pers. comm.; Woods, pers. comm.). Winter is a limiting season to deer populations within the Peace region because of cold temperatures and snow depths that limit movement and forage availability (Goulet and Haddow, 1985; Barton et al., 1998; Madrone Consultants Ltd., 1998).

Mule deer require the combination of steep, south aspect slopes, low snow depths and adjacent cover for suitable winter range (Churchill, pers. comm.). Unlike moose, deer are affected to a greater degree by increased snow depths, and habitat use is largely influenced by snow depths (Woods, pers. comm.). Percent slope and elevation requirements depend on snow depths, as deer will utilize any elevation that is not limited by snow (Woods, pers. comm.). South aspect slopes appear to be the most important factor to mule deer winter range, as they create low snow conditions and easy access to forage (Goulet and Haddow, 1985; Hatler, 1990; Elliot, pers. comm.; Woods, pers. comm.). Mule deer within the region use a variety of south aspect habitats, ranging from dry, open, vegetated slopes to aspen dominated slopes (Goulet and Haddow, 1985; Hatler, 1990). Winter habitat selection may also depend on the status and availability of agricultural crops, important in some areas of the Peace Lowlands (Woods, pers. comm.). Mule deer winter habitats require a cover component for snow interception, and security and thermal requirements (Elliot, pers. comm.). Cover, however, is not as critical to mule deer as it is to white-tailed deer (Elliot, pers. comm.). Mixedwood cover is preferred for mule deer as it provides a balance of snow interception and adequate forage species. Snow interception is maximized in coniferous forests, but hardwood forests provide the most ample food source for mule deer (Elliot, pers. comm.).

Habitats required by mule deer have been identified in a number of areas within the Peace region. Open, south aspect slopes of the Peace River, Moberly River, Beatton River, Pine River, Halfway River, Cache Creek, Golata Creek and Alces Creek have been identified as critical mule deer winter range areas within the Peace region (Elliot, pers. comm.; Woods, pers. comm.). All river valleys that have south-facing slopes within the region also have the potential for winter habitat and should be recognized as such (Woods, pers. comm.). Within the Liard River valley, the majority of mule deer were observed along the north shore of Liard River, between Liard Hotsprings and Mould Creek (Goulet and Haddow, 1985). There have also been reports of mule deer wintering on the open, south facing slopes of Mount Ole (Goulet and Haddow, 1985).

These areas provide southern river breaks that have low snow depths during the winter and provide the browse vegetation required by mule deer. Mule deer winter diets were examined by Corbould (1998) in the Peace Arm and Ospika River drainages. During winter months, mule deer are browsers, feeding on deciduous shrubs, coniferous vegetation and occasionally on arboreal lichens in mature coniferous forests (Corbould, 1998). Fecal fragment analysis of mule deer pellets from the Peace Arm determined graminoids, shrubs and conifers to be the main forage species eaten (Corbould, 1998). A seasonal shift in species use occurred between early and late winter, with graminoids becoming less abundant, and lodgepole pine fragments becoming more abundant in fecal samples during January and February. Shrubs consistently comprised 80 to 85% of winter diet from November to March. Within the Ospika River

drainage, species most commonly used were willow, pasture sage (*Artemisia frigida*), lodgepole pine and juniper (*Juniperus*) spp. (Corbould, 1998).

Grazing activity by domestic animals is critical to the maintenance of ungulate winter range, specifically mule deer range (Elliot, pers. comm.). South facing, grassy slopes and shrub communities are easily trampled and destroyed by domestic livestock, degrading the quality of the winter range for mule deer. Grazing activity should be eliminated from critical winter range areas to secure the quality of the habitat (Elliot, pers. comm.).

Table 2. Summary of mule deer winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Misinchinka Ranges	16		South aspects are key habitat selection factor		Northern Williston Reservoir area
Peace Lowlands	43, 45, 53	Steep slopes required	South and west aspects	Most favourable elevations are ones that provide the lowest snow depths	Slope and elevation requirements are largely dependent upon snow depths
Liard Plain/Hyland Plateau/Muskwa Upland	14		South aspects are key habitat selection factor		Liard River Valley area

2.3 White-tailed Deer

Very little is known about winter range habitat of white-tailed deer within the Peace region, and much is taken directly from the provincial species account. Woods (pers. comm.) reports that there is no predictable winter range habitat in the Peace region, largely due to a lack of studies conducted on the species regionally.

Similar to mule deer, white-tailed deer are limited by snow depths; influencing movement, forage availability and thus habitat selection (Churchill, pers. comm.). White-tailed deer, however, have an important requirement for cover, more so than mule deer (Churchill, pers. comm.; Elliot, pers. comm.). Cover requirements are of primary concern to white-tailed deer winter range, and are believed to be the determining factor for habitat selection and use (Churchill, pers. comm.). Patches of forest cover greater than 16 hectares is required for white-tailed deer winter range, and openings within forest patches are utilized for feeding (Churchill, pers. comm.). Mixedwood cover provides the best combination of thermal protection and forage supply, and has greater cover value for winter range (Churchill, pers. comm.). Deciduous is ranked higher than coniferous forest cover (Churchill, pers. comm.).

2.4 Rocky Mountain Elk

Elk are generalist feeders that feed on grasses and other non-woody vegetation, but will utilize browse if required (Peck, pers. comm.). Because of their forage preferences, elk generally require open, grass-dominated, south aspect slopes (Elliot, pers. comm.). However, a number of different habitat types can be used if forage requirements are met. Other habitat types that are used by wintering elk include agricultural areas, prescribed burns, riparian habitats and possibly cut blocks, under favorable conditions (Churchill, pers. comm.; Peck, pers. comm.; Wood, pers. comm.; Madrone Consultants Ltd., 1998; TerraMar Environmental Research, 1999). Burn areas are of paricular importance for elk habitat because of the grassland communities that establish post-burn (Woods, pers. comm.). Many areas in the northern mountains have been burned naturally, and artificially for the purpose of supplying suitable elk winter range (Woods, pers. comm.). Southern breaks and south aspect slopes are dually important for their available graminoid and shrub communities (Woods, pers. comm.). Forage availability, quantity and quality, snow depths and potentially the amount of disturbance in an area determine winter habitat use by elk (Peck, 1987; Churchill, pers. comm.).

A number of studies have been completed on elk forage preferences within selected areas of the Peace region. Fecal fragment analysis was used to determine forage use by elk in the Peace Arm and Ospika River areas (Corbould, 1998). The Peace Arm area showed grasses and shrubs to make up 63% and 23% of fecal samples, respectively. The most common graminoid and shrub species identified included *Elymus innovatus*, *Oryzopsis* spp., *Calamagrostis canadensis* and *Salix* spp. (Corbould, 1998). These pellet samples were collected from aspen-grassland habitats of the Peace Arm. Habitats of the Ospika river area were dominated by conifers, and had a lower percentage of grassland areas. Fecal samples from the Ospika River area were dominated by lichens (47% of sample), and graminoids were much less prevalent in the sample. Lower graminoid content is probably due to greater snow depths in this area (Corbould, 1998). Corbould (1998) suggests that elk winter diets are largely determined by the habitat and what is available for forage.

Forage habits of elk were observed in the Tuchodi River area by Peck (1987). During mid-winter, 61.8% of forage use was shrubs, 35% was grasses and a very small proportion of herbs were used. Willows comprised half of the total shrub use, with balsam poplar and aspen common in the samples. Hairy wild rye (*Elymus innovatus*) and smooth brome (*Bromus inermis* ssp. *inermis*) were the most utilized grass species. Peck (1987) describes that use of grass increased from January to February. During late winter, shrub use declined from 61.8% in mid-winter, to 38.5% in late winter. Trembling aspen was the primary shrub species used. Grasses became the most frequently used forage species in late winter, with hairy wild rye and smooth brome making up 80% of the total grasses used. *Calamagrostis canadensis* was also used extensively, but only in selected areas. Rumen analysis conducted by Peck (1987), showed similar trends, with browse making up the primary component of late fall diets (approximately 60%, and grasses were the primary component of winter diets (51%). Selected forbs (scouing rush, American vetch and prairie sage) consistently comprised 20% of both late fall and winter diets (Peck, 1987).

Snow depths are a significant variable in determining elk habitat use during winter, and have been described as the most limiting factor for elk during the winter (Backmeyer, 2000c). Increased snow depths can limit both movement and forage availability. Peck (1987) describes the highest elk densities were observed on upland, south facing slopes characterized by low snow accumulations. As snow depths increased, older vegetation associations were used (Peck, 1987). Webster (pers. comm.) also describes the use of timber with high snow accumulations. Snow depths can limit distribution of elk during winter, and higher elevations are generally not used because of high snow depths (Churchill, pers. comm.). Peck (1987) found that during severe winters, elk were widely distributed across a variety of habitats. Habitat use in the Tuchodi River area was largely influenced by forage availability, which is related to snow accumulations (Peck, 1987). Grasslands were used with snow depths of 20 cm, but with increased crusting and snow depths exceeding 30 cm elk shifted towards shrub-dominated communities. During late winter, elk would use grassland habitats during mid-day, when solar radiation softened the crusted snow, and allow access to forage beneath (Peck, 1987). Churchill (pers. comm.) discusses south facing slopes to be of importance when snow depths exceed 40 cm, preventing elk from cratering for forage. Upland grass and shrub communities appear to be the preferred winter habitat, if not limited by high snow accumulations (Peck, 1987). However, older vegetation associations are important during severe winters, when snow accumulations restrict foraging activity, and for cover purposes (Peck, 1987).

A number of studies have documented elk habitat use throughout the Peace region. These have been outlined according to geographical areas.

- The north shore of the Peace Arm, stretching from the W.A.C. Bennett Dam to the Nabesche River, provides excellent elk winter range (Culling, pers. comm.; Wood, pers. comm.). These areas, below 1000 m, have been designated as elk winter range, and prescribed burning within the area continually enhances the quality of the winter range for elk (Wood, pers. comm.). Agricultural areas along the north shore provide good winter range habitat, and aspen slopes and hillsides are also used (Wood, pers. comm.). Aerial surveys in 2000 showed high quality winter range east of Schooler Creek, characterized by south aspect slopes dominated by aspen and open shrub/grassland habitat (Hengeveld and Wood, 2001). Over 430 elk were observed in these high quality areas.
- An area between Butler Ridge and Adams Creek on the north shore of the Peace Arm has been characterized as a core area for elk winter range (Backmeyer, 2000c). During early winter, elk were located in shrub/grassland habitat types. Throughout late winter, nearly 70% of locations of radio-collared animals were in shrub/grassland habitat types (Backmeyer, 2000c). In particular, the Branham Slide area provides similar slope and aspect qualities to the core winter range, but is dominated by trembling aspen. Elk were observed in the Branham Slide area, but at significantly lower densities than the core range (Backmeyer, 2000c). Elk in the Peace Arm area appear to be resident animals, making no significant movements between summer and winter ranges (Backmeyer, 2000c). In addition, coniferous cover is strongly avoided by elk in the area, suggesting that snow depths are not a limiting factor (Backmeyer, 2000c).

- Smaller elk populations are also located on the south shore of the Peace Arm (Wood, pers. comm.). The south shore, however, is more forested, but cut blocks in the area have provided secondary winter range for a small number of elk (Wood, pers. comm.).
- The Tuchodi River, Gatho Creek, Sikanni Chief River and Muskwa River are the primary winter range areas for elk in the northern mountains (Peck, pers. comm.; Woods, pers. comm.). These areas will also receive a number of elk that migrate from the Fort Nelson local population to the Tuchodi area during winter. However, this migration is often sporadic and not all animals of the Fort Nelson population migrate.
- Several areas within the Fort Nelson region have been able to locally support elk populations (Peck, pers. comm.). These elk are often associated with slash-logged areas and south facing river breaks. Peck (pers. comm.) suggests that these elk have been pushed out of prime winter range areas by high populations, and have been able to survive in these secondary winter ranges under the favourable winter conditions. However, if climate conditions change and winters become more severe with greater snow depths, Peck (pers. comm.) suggests that these elk will likely be eliminated, as these secondary winter ranges may not be sufficient during harsh winters. Sporadic migration from the Fort Nelson area to the Tuchodi River valley occurs during the winter.
- South aspect river breaks of the Pine, Moberly, Murray and Wapiti Rivers are important winter habitat for elk (Webster, pers. comm.; Woods, pers. comm.).
- Within the Liard River valley, the majority of elk observations were in alluvial/riparian (50%) and subalpine (22.2%) habitats types (Goulet and Haddow, 1985). Willow shrubland and white spruce-fir forests characterized the subalpine habitats. There is a large section of elk winter range along the rolling hills and low, flat valleys of the Liard River drainage that was created through a natural fire occurring in 1971. Elk pellet groups were observed in willow shrubland, subalpine spruce-fir forests, low elevation burns with deciduous re-growth, dry aspen slopes, pine-spruce forests and bog birch shrubland (Goulet and Haddow, 1985). Goulet and Haddow (1985) describe suitable winter range to be available in small isolated patches in the Kechika and Toad River riparian valleys, and in the young burns and grassy slopes along the north shore of the Liard River between Mould and Brimstone Creeks.
- In the northeast portion of the Williston Reservoir watershed, elk were observed primarily in burn habitats, on open, steep deciduous dominated south facing slopes (Hatler, 1990).

Elk have been increasing in numbers throughout the region. This has caused conflicts, especially in the Peace Lowlands, where elk have become destructive in agricultural settings and a nuisance to local farmers (Elliot, pers. comm.). Because of this conflict, elk are hard to manage for within the Peace Lowlands and southern parts of the region (Elliot, pers. comm.). Elk also compete for forage resources with both sheep and, occasionally, moose in areas of overlap (Luckhurst, 1973; Culling, pers. comm.; Peck, pers. comm.). In the Nevis Creek valley, Luckhurst (1973) describes elk to use alpine habitat in south and southwest aspect slopes, which are depended on by Stone's sheep during the winter. In higher elevation areas, sheep may be negatively affected by the competition imposed by elk. This has been observed specifically along the north shore of the Peace Arm, where extensive burning for elk has been detrimental to sheep in the area (Culling, pers. comm.).

2.4.1 Foothill Populations vs. Lowland Populations

Provincial standards describe Rocky Mountain elk to require significant security and thermal cover in conjunction with foraging habitat (RIC, 1999). Cover is required for its low snow accumulations, allowing access to forage, and for security and thermal purposes. Within the Peace region, however, cover properties do not appear to be as important, as observed in other areas of the province (Churchill, pers. comm.). Cover is used primarily for security purposes, when disturbances are encountered, rather than for thermal protection from weather conditions (Churchill, pers. comm.). Within the Peace region, cover requirements vary with different elk populations (Backmeyer, pers. comm.; Churchill, pers. comm.; Woods, pers. comm.). This cover requirement is what segregates Peace region elk into two groups. These two groups differ in their use of winter habitat, primarily cover requirements, and thus habitat use for each group is described separately.

Elk in the mountainous and northern foothill regions, specifically the Tuchodi River and Gatho Creek populations, do not make extensive use of cover. Within the Tuchodi-Gatho area where elk are abundant during the winter, cover attributes are almost non-existent and the elk make very little use of cover throughout the winter (Webster, pers. comm.; Woods, pers. comm.). Elk are observed primarily on widespread, south aspect, grass-shrub community slopes, with little to no cover in close proximity (Webster, pers. comm.; Woods, pers. comm.).

Conversely, elk in the southern parts of the Peace region (Graham River, Murray River, Pine River and Moberly River areas) make extensive use of cover during the winter (Woods, pers. comm.). It is possible, that because of the large abundance of open, grassland slopes and therefore, lower snow depths in the northern foothills, elk do not require cover attributes during the winter. Snow depths decrease in more northern parts of the region. Woods (pers. comm.) suggests snow depths to be the deciding factor to the extent that elk will utilize cover. The Graham, Moberly and Pine River areas receive large amounts of snowfall throughout the winter, and therefore, elk make greater use of cover in these regions. In the Tuchodi-Gatho area, snow depths are not limiting, and elk do not move to forested areas (Woods, pers. comm.).

Churchill (pers. comm.) suggests that the lack of cover used in foothill regions can be attributed to lower disturbances and activities during the winter in the region. Churchill (pers. comm.) found that elk would retreat to and remain in cover, in response to disturbances within 3 km, and not for thermal purposes. This has been supported by recent observations of elk within the Peace Lowlands. Elk are making extensive use of agricultural areas within the lowlands, but are only observed during early morning or at night (author, personal observations; Backmeyer, pers. comm.; Churchill, pers. comm.; Peck, pers. comm.; Woods, pers. comm.). Churchill (pers. comm.) suggests this is because of reduced human activity/disturbance at these times.

Table 3. Summary of Rocky Mountain elk winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Hart Foothills	53		South aspects along river breaks are critical		Pine, Moberly, Murray and Wapiti Rivers provide excellent south aspect slopes for elk winter range
Peace Foothills	19, 44, 52		South aspect slopes	Key winter range areas are below 1000 m	North shore of the Peace Arm
Misinchinka Ranges	16	Elk were observed using steep slopes	South facing slopes were used in all elk observations		Northeast portion of Williston Reservoir
Muskwa Foothills	22, 25, 43, 51, 53	Moderate slopes used with favourable aspects	Elk used south and southwest aspects	Higher elevations *not* utilized because of limiting snow depths	Nevis Creek area; Tuchodi River area

2.5 Woodland Caribou

Winter habitat use by woodland caribou (*Rangifer tarandus caribou*) within the Peace region is highly unknown, and appears to change over time for reasons unknown (Webster, pers. comm.). For these reasons, it makes designation of winter range for caribou difficult and highly variable. Primarily, little is known of the specific habitat use of caribou within the Peace region, and varying climate regimes, topography, disturbance and predators influence the winter use of habitat by caribou in some form.

This is apparent in the habitat use of different caribou herds within the Peace region. Caribou in the southern part of the region, where ESSF forests and greater snow depths exist, tend to follow the patterns exhibited by the mountain caribou ecotype. In more northern parts of the region, topography and snow fall patterns change, influencing winter habitat use that resembles the northern ecotype of caribou. However, within the northern ecotype designation, there is a high degree of variability and current studies suggest that the northern ecotype caribou within the Besa-Prophet area do not follow the characteristics of other northern ecotype caribou within the region (Gustine, pers. comm.). However, a limited amount of data has been collected to support this anomaly, and conclusions have yet to be drawn from the study (Gustine, pers. comm.). The study does, however, suggest that caribou winter range may currently not be what it was in the past.

Due to a large variability, habitat use will be described based on species ecotype, and reported for specific geographic areas and regions within the Peace region.

2.5.1 Boreal Ecotype

Of the three woodland caribou ecotypes in the Peace region, the boreal caribou are probably the least studied and relatively little is known with regards to their habitat use during the winter (Churchill, pers. comm.). The boreal ecotype is characterized by small, dispersed and relatively sedentary bands of caribou that utilize and remain in the flat peatlands or muskeg areas of northeastern BC and northern Alberta (Churchill, 2002). Boreal caribou make horizontal seasonal movements, rather than the vertical seasonal movements observed in the northern and mountain ecotypes. This ecotype is considered non-migratory; existing, rather, in areas with low ungulate densities and in small, scattered groups as a predator avoidance strategy. They feed primarily on terrestrial lichens, which are most common in the wet muskegs and open forests of the BWBS zone. The caribou rely on large tracts of mature forests for supplying forage opportunities. However, mature forests are most critical when in conjunction with adjacent peatlands. Churchill (pers. comm.) describes the most important habitat variable is the interspersion and connectivity of mature forests, for forage, with large areas of peatlands, for dispersion. Churchill (pers. comm.) suggests predator avoidance and maintaining dispersion, rather than selecting habitats for their forage qualities is the primary influence in habitat selection by boreal caribou. Boreal caribou maintain dispersion by selecting habitats that are not used by other ungulate species and by maintaining small groups of individuals (Churchill, pers. comm.). Boreal caribou use all variants of the BWBS, except BWBS Sdk2, with the greatest use occurring in the wetter sites of the BWBS (variants Smw1 and Smw2) (Churchill, 2002).

Boreal caribou in the Fort Nelson area use similar wintering strategies. Boreal caribou do not migrate to the mountains, but remain in the swamps and muskegs throughout the winter (Culling, pers. comm.). They are found strictly in black spruce and sphagnum wetlands, making very little to no use of upland areas (characterized by aspen slopes and hummocky terrain) (Culling, pers. comm.). Throughout the winter, boreal caribou remain widely dispersed and rarely congregate into groups larger than 8 individuals. In the Fort Nelson area, there is a large complex of wetlands, stretching for many kilometers, which are heavily relied upon by caribou throughout the winter (Culling, pers. comm.). Caribou rarely leave these wetlands during the winter. However, some caribou may move between complexes, while others will remain in one complex through the entire winter. These wetland areas are critical during the winter, but are also heavily used year-round. Culling (pers. comm.) described boreal caribou to consume both arboreal and terrestrial lichens, depending on snow depths.

Boreal caribou have been studied in the Pedigree study area, located in northeastern BC and northwestern Alberta areas of the Chinchaga River. Boreal caribou within the herd/geographical area occasionally move between Alberta and British Columbia, and have been observed in the Milligan Creek area of northeastern BC. This area is characterized by white spruce, lodgepole pine, black spruce and trembling aspen communities (Hornbeck and Moyles, 1995). Caribou movement patterns during the winter were studied through relocation of 5 radio-collared caribou (Hornbeck and Moyles, 1995). The caribou in the study area showed no seasonal movement patterns. However, under a severe snow year (85-105 cm), all caribou showed wide-ranging movements throughout the winter. Summer and winter ranges were not geographically distinct, home ranges were highly variable between years, and seasonal migrations were not observed in the Pedigree caribou herd (Hornbeck and Moyles, 1995). Specifically, winter ranges were compared across a number of winters, and no distinct area was used each winter. Caribou winter ranges in the Pedigree area changed from year to year, and were separated by distances of 30 to 80 km between years (Hornbeck and Moyles, 1995). Habitat use in the Pedigree area did have seasonal differences. During the winter, caribou selected for herbaceous habitat associated with wetland margins. Specifically, caribou used treed muskeg and scrub conifer more than these habitats were available across the landscape. Habitats that supported scrub conifer/black spruce forests in complex mosaic patterns with upland lodgepole pine and spruce forests were selected for by wintering boreal caribou (Hornbeck and Moyles, 1995).

A small number of boreal caribou were observed in west-central Alberta (less than 100 individuals). These animals were observed using habitats dominated by pine-spruce forests (40% of caribou observations), treed muskeg (31%) and pine forests (19%) (Edmonds and Bloomfield, 1984). Half of the animals observed were in elevations between 1201 to 1350 m, using south aspects. Over 85% of caribou observed were in flat terrain, with no caribou observed on slopes greater than 5% (Edmonds and Bloomfield, 1984). Edmonds and Bloomfield (1984) describe the use of grassland meadows by boreal caribou within the study area. This is uncommon for the boreal ecotype, but due to the availability of the meadows, the habitat was used more than expected (Edmonds and Bloomfield, 1984). Aspen and mixed aspen-coniferous forests were strongly avoided by the boreal ecotype; lodgepole pine and pine-spruce forests were used extensively for all activities throughout the winter (Edmonds and Bloomfield, 1984).

Table 4. Summary of boreal ecotype Woodland Caribou winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Clear Hills	21	Flat terrain utilized			Pedigree Study area (Chinchaga River)
Front Ranges of Alberta	13	All caribou observed were in flat terrain, with no observations of caribou on slopes greater than 5%	Used south aspects	Observed in elevations between 1201-1350 m	West-central Alberta

2.5.2 Northern Ecotype

The northern ecotype is the most common caribou ecotype observed in the Peace region. This commonality can be associated with the lower snow depths and different weather patterns due to the leeward position of the region to the Rocky Mountains. Areas west of the Peace region receive greater snowfalls, thus influencing caribou behaviour and habitat use. However, within the northern ecotype, there are many "variations" in how habitat is used and selected throughout the winter.

In general, northern ecotype caribou spend early winter in low elevation forests and late winter in high elevation, windswept alpine areas (Wood, 1996). Windswept ridges and exposed alpine areas provide access to available forage, and timbered areas provide good snow interception, and access to forage. As winter progresses, snow depths may force caribou to high elevations where snow depths are less restricting. This typical northern ecotype winter strategy is observed in the Graham River caribou herd (Culling, pers. comm.). The Graham caribou have typical west to east migrations in response to accumulating snow. The animals move to the front range of the Rocky Mountains, where snow depths are lower. Areas commonly used by the Graham herd include Hackney Hills, Butler Ridge, Aylard Ridge and the area between Horseshoe Creek and the Chowade River (Backmeyer, 2000a; Culling, pers. comm.). Accumulating snow depths appear to be the controlling factor to the extent at which caribou will move. This became more apparent in the 2002-2003 winter, where snow depths were much lower than normal (Culling, pers. comm.). Caribou did not move as far east as in previous years because there were low snow accumulations until very late in the winter (Culling, pers. comm.). Graham caribou remained in the timber for an extended time during this year, and did not come up to the alpine as snow depths were not restricting to cratering activities (Culling, pers. comm.). Pine, spruce-fir and subalpine forests were used by wintering caribou in the Graham River area (Culling, pers. comm.).

This typical northern ecotype regime is followed throughout much of the lower part of the Peace region (on the east side of the Rocky Mountains south of Dawson Creek). However, in areas of the Rocky Mountain divide, caribou show a cross between mountain and northern ecotype habitat use (Seip, pers. comm.). Some animals will remain in windswept alpine throughout the winter, making no migration to lower elevations. Other caribou will move to lower elevation

pine-spruce forests as observed in the northern ecotype. There is, however, no accurate way of predicting which caribou herds or individuals will select which wintering strategy. In the Williston Reservoir area, Seip (pers. comm.) is currently monitoring caribou from four distinct herds: Kennedy-Siding Herd, Moberly Herd, a herd west of Tumbler Ridge, and a herd in the Quintette area. Each of these herds shows very distinct habitat selections and wintering strategies. The Kennedy-Siding herd strictly uses the pine-lichen flats. The caribou remain in these pine-lichen cut blocks and open areas until snow depths become restrictive for cratering, limiting lichen availability (Seip, pers. comm.). In response to increasing snow depths, caribou move into the adjacent pine-lichen forests. If snow depths remain at cratering levels, caribou will remain in the pine-lichen forests. However, with greater snow depths, the caribou respond and move into the subalpine forests and the windswept alpine if snow depths continue to increase (Seip, pers. comm.). The Moberly herd, conversely, remain in the windswept alpine throughout the duration of the winter (Seip, pers. comm.). A herd, located west of Tumbler Ridge, also shows complete use of the windswept alpine for the duration of the winter. However, the herd in the Quintette area, relatively close to the Tumbler Ridge herd, moves out of the mountains to pine-lichen stands in the east for the winter months (Seip, pers. comm.). It is unknown why herds in similar areas would select different wintering strategies.

East of the Rocky Mountains, caribou use the northern ecotype winter strategy. Caribou located along the divide use a combination of mountain and northern ecotype habitat use. North of the Peace River, there are a number of caribou herds that remain in the windswept alpine, and others that move out to pine-lichen stands. In areas farther north and in closer proximity to "boreal ecotype habitat" another combination of wintering strategies is observed. Some northern ecotype caribou have begun moving out to the muskeg-black spruce forests during late winter, behaving like the boreal ecotype (Woods, pers. comm.).

Local biologists describe that caribou winter range has changed over the past 10 to 20 years, especially in northern areas of the region (Webster, pers. comm.; Woods, pers. comm.). Caribou individuals and herds are beginning to winter in areas where caribou have never been observed using before (Woods, pers. comm.). Specifically, caribou are frequently using areas east of the Alaska Highway, in greater numbers and for longer periods than observed in the past (Webster, pers. comm.; Woods, pers. comm.). These caribou are moving into the lower, flat areas east of the highway, away from the foothills and mountains west of the Alaska Highway. In the Snake/Sahtaneh River area, caribou are primarily of the boreal ecotype. However, a TEM project in the area reports a number of the northern ecotype caribou migrating east to "boreal caribou habitat" during the winter (TerraMar Environmental Research, 1999). In addition, preliminary GPS locations of caribou in the Besa-Prophet River area show extensive movements to the east side of the highway. However, Gustine (pers. comm.) also reports that some caribou from the Besa-Prophet remain in the windswept alpine and others utilize the low elevation forests. More than anything, this suggests that very little is known about how caribou utilize habitats during the winter. Few studies have been done to determine why caribou make winter migrations in some areas, and not in other areas. Migration may be influenced by the availability of pine-lichen stands within traveling distance, the influence of predators, forage availability/quality, or snow depths (Seip, pers. comm.).

Numerous studies have been done in areas of west-central Alberta and within the Peace region that provide data on caribou habitat use. Because of apparent differences in habitat use by northern caribou throughout the region, the use of different habitats, elevations, aspects, and vegetation types are outlined according to each specific study and study area.

- Caribou were studied in the Quintette Coal area from 1982 to 1985 (Sopuck, 1985). Caribou in the area used primarily open subalpine and alpine ranges (41-55% of caribou). The remainder of caribou observed were in lowland forests, located north and east of the Quintette plant site (Sopuck, 1985). Caribou using forested habitats showed much greater movements than caribou using the alpine habitats, possibly due to limited forage in alpine habitats and snow conditions in the lowland forests (Sopuck, 1985). Sopuck (1985) described the use of low elevation, coniferous forests increased during the winter (specifically after December). During early winter, subalpine conifer was used until snow depths became limiting. Coniferous forests at elevations below 1500 m were preferred because of greater snow interception. A number of caribou remained in the windswept alpine and did not move down to low elevation forests. The use of south and north aspects was similar throughout the winter, and caribou showed little preference for aspects in the area. Sopuck (1985) suggests aspect is chosen based on the combination of solar radiation, wind and slope, creating the most favourable snow and forage conditions. Slopes greater than 10° were not used during the winter. Critical winter range areas for northern caribou include Quintette, Roman and Windy Mountains, based on high caribou use during the winter (Sopuck, 1985).
- A herd of caribou within the Akie-Ospika River area of the Mackenzie Forest district has been extensively monitored by Slocan Forests Products (McNay, pers. comm.). Although the caribou lie outside the boundaries of the Peace region, a number of individuals have traveled into the Pink Mountain area of the Peace region for winter range (Zimmerman et al., 2001; McNay, pers. comm.). When wintering in the Pink Mountain-Besa River area, caribou use a mixture of valley bottom habitats in a dispersed fashion. During late winter, caribou group up and move to the high elevation open alpine habitats (McNay, pers. comm.). The Akie-Ospika caribou exhibit typical northern ecotype behaviour and habitat use. During early winter, caribou use managed landscapes in lower elevations, foraging for terrestrial lichens (Zimmerman et al., 2001). These low elevation areas are characterized by nutrient poor, lodgepole pine habitats. During late winter, alpine and subalpine areas are used; particularly the windswept slopes that have exposed terrestrial lichens (Zimmerman et al., 2001). Hatler (1990) described all caribou in the area were observed in high elevation alpine habitats between 1375 to 1850 m.
- Four herds of northern caribou have been identified in west-central Alberta: Calahoo, Narraway, Lingrell and Redrock/Prairie Creek (Brown and Hobson, 1998). These caribou and their habitat use are important to the Peace region because of similar habitat use between caribou in the Peace region and in west-central Alberta (Churchill, pers. comm.). In addition, the Alberta herds use both Alberta and BC areas during the winter (Brown and Hobson, 1998). The Calahoo herd is located near the Wapiti River, with winter ranges spanning the BC-Alberta border. Currently, there are three low elevation caribou winter ranges recognized in BC, which are used by caribou of the Calahoo herd (Brown and Hobson, 1998). The Narraway herd uses a large plateau that spans the BC-Alberta border. Winter locations from this herd have been obtained from caribou located

in the mountains between Red Deer Creek and Belcourt Creek, in the Peace region (Brown and Hobson, 1998). These northern caribou regularly use pine and mixed conifer (pine/spruce) forests during the winter; however, some caribou are known to remain in the mountains, using windswept ridges and alpine habitats for the duration of the winter (Brown and Hobson, 1998). Whether caribou remain in the mountains or move to lower elevations was largely determined by snow accumulations (Brown and Hobson, 1998). Snow depth also determined the extent that meadows were used. Meadows were commonly used for foraging during the winter when snow conditions were low, allowing for cratering activities (Brown and Hobson, 1998). Lichens made up 85% of winter diets (Brown and Hobson, 1998).

- A herd of northern caribou reside in the Graham River area; population size estimated at approximately 800 animals (McNay et al., 1999). Caribou in the area utilize 2 distinct winter habitats: the windswept alpine, and low elevation boreal forests (Backmeyer, 2000a). Backmeyer (2000a) describes habitat selection to be likely dependent on snow depths, varying through each winter. During early winter, caribou in the Graham River herd used both alpine/subalpine habitats and low elevation ESSF forests (Backmeyer, 2000a). Important geographic areas used by wintering Graham caribou include Butler Ridge, Hackney Hills and the area between Horseshoe Creek and the Chowade River (Backmeyer, 2000a).
- In the foothills of west-central Alberta, caribou use of habitats was influenced by snow depths (Benn and Bloomfield, 1981). During milder winters, open feeding areas, such as meadows, were used (Benn and Bloomfield, 1981). Edmonds and Bloomfield (1984) found meadows used in the same area, were within 100 m of cover. Under severe winter conditions and deep snow, caribou spent more time in forested forage areas. Lodgepole pine and pine-spruce communities were the most commonly used forest type. These forested habitats were used when in conjunction with cleared areas that provided forage opportunities (Benn and Bloomfield, 1981). Forested areas received the highest use during late January and February when meadows and open areas had restrictive snow depths. Use of forested habitats decreased as snow conditions became more favourable to cratering activity. The caribou studied showed little preference for aspect during the winter. Caribou showed very little use of slopes greater than 15%, and preferred flat terrain (Edmonds and Bloomfield, 1984). Sixty percent of caribou observations were between 1351 to 1500 m. Sixteen to 19% of caribou observations were located between 1201 to 1350 m and 1501 to 1800 m, respectively (Edmonds and Bloomfield, 1984). Snow depths were not limiting in the area, as caribou were observed cratering in deep snowfall years (average of 62 cm) throughout the winter and into spring (Edmonds and Bloomfield, 1984)
- The Berland-A La Peche caribou herd is located in west-central Alberta, south of Grande Cache. This caribou population is of importance because a large portion of its winter range falls within the British Columbia Forest Products lease (Bloomfield et al., 1981). The majority of animals from this population utilize lodgepole pine, pine-spruce and meadow communities. Foraging was concentrated in mature forest types and in open meadows. Snow conditions and depths determined which forage community would be used. Under deep snow and crusty conditions, feeding activities shifted to forest habitat types (lodgepole pine, pine-spruce and muskeg habitat types). Flat to moderate slopes with south, east and west aspects were used most prominently.

- Caribou on the south and north sides of the Peace Arm have been extensively studied. Caribou observed on Mount McAllister, Frank Roy and Stephenson showed primary use of the alpine tundra and subalpine krummholz habitats between 1300 to 2000 m (TERA, 1995a). Backmeyer (1991) also reported extensive use of alpine areas above 1300 m. Alpine and high subalpine areas appear to be of the greatest importance for winter habitat, but forested travel corridors between the mountains and isolated alpines show importance for movements between alpine areas (Backmeyer, 1991; TERA, 1995a). Caribou winter range in the Peace Arm area is characterized by higher elevation alpine and subalpine ridges (TERA, 1995b). These areas have lower snow depths, thus exposing terrestrial lichens. During late winter, windswept ridges are an important component of winter habitats. Caribou do not appear to make use of heavy forested stands or cut blocks (TERA, 1995b).
- In the Liard River valley, 89.6% of caribou observations were in upland coniferous habitats (Goulet and Haddow, 1985). Lodgepole pine and pine-spruce forests characterize these habitats. Alpine tundra was an important aspect of caribou winter range in the Grayling River area (Goulet and Haddow, 1985).
- In the Vents River drainage, caribou showed a preference for lodgepole pine-white spruce forests, making extensive use of these mature upland coniferous forests (Norecol Dames and Moore Ltd., 1998). During early winter, caribou concentrate feeding activities in the alpine tundra and SWBmk2 biogeoclimatic zones until snow becomes limiting. As snow depths increase, feeding activities shift to the SWBmk and BWBSdk2, using mature stands of lodgepole pine or mixed black/white spruce forests that provide abundant terrestrial lichens. During late winter, caribou rely on the terrestrial and arboreal lichens available in low elevation forests. Cratering activities are usually not impeded by excessive snow depths in the area. However, if snow conditions do not allow for cratering, caribou may move to windswept alpine areas to access exposed ground vegetation (Norecol Dames and Moore Ltd., 1998).
- Caribou in the Misinchinka Ranges use upper ESSF subalpine forests (Hengeveld and Wood, 1998). These habitats were used even when windswept alpine were available. Hengeveld and Wood (1998) discuss the habitat use and winter behaviour of these animals is more indicative of mountain ecotype caribou, rather than northern ecotype. However, it is not known the extent to which these caribou use low elevation forests in the Misinchinka Ranges (Hengeveld and Wood, 1998).

Forage preference among northern caribou is fairly consistent across the region. Northern caribou utilize a variety of forage items, ranging from terrestrial and arboreal lichens to sedges, grasses and various forbs. Forage use has been analyzed primarily in west-central Alberta caribou populations. Based on direct observations and crater investigations, Benn and Bloomfield (1981) found *Cladonia* spp., *Vaccinium vitis-idaea* and *Cladina mitis* were the most frequent species encountered. Other species that were common in craters included *Peltigera aphthosa*, *Stereocaulon* spp., *Ledum groenlandicum* and a variety of Bryophytes that are usually consumed because of their association with lichens. Arboreal lichen use was apparent only in areas of deep snow, where terrestrial lichen production was absent, and along blowdown pipelines (Benn and Bloomfield, 1981). Pellet analysis collected on caribou winter range in west-central Alberta showed terrestrial lichens to be the primary forage species used (Edmonds and Bloomfield, 1984). Terrestrial lichens that were common included species of *Cladina*,

Cladonia, *Cetraria*, *Stereocaulon* and *Peltigera* (Edmonds and Bloomfield, 1984). Lodgepole pine was the most abundant coniferous tree used for forage. As snow depths increased, terrestrial lichen fragments decreased and shrub fragments became more abundant in pellets (Edmonds and Bloomfield, 1984).

Forage preference in the Berland-A La Peche caribou herds was primarily arboreal lichens (*Bryoria* and *Usnea* spp.) and terrestrial lichens (*Cladonia mitis*, *Cladonia rangiferina* and *Cladonia gracilis*) (Bloomfield et al., 1981). Grasses and sedges, primarily *Vaccinium vitis-idaea* and *Ledum groenlandicum*, were also consumed (Bloomfield et al., 1981). The majority of cratering activity occurred in lodgepole pine and meadow communities, but was also observed in mixed coniferous, white spruce and lodgepole pine-white spruce forests. Lodgepole pine forests provided the highest terrestrial lichen biomass (average of 985 kg/Ha), and meadows produced the lowest (average 10 kg/Ha). However, meadows provided a large grass and sedge component, which likely supplements a lichen-based diet (Bloomfield et al., 1981).

Pine-lichen stands are of critical importance to many caribou herds throughout the Peace region, specifically the northern ecotype, for their forage values. These vegetation communities are important with regards to management because of their high timber values associated with lodgepole pine stands and the high abundance of caribou forage species produced. Pine-lichen stands in northeastern BC are not very abundant, nor are they of good quality for foraging caribou (Seip, pers. comm.). Seip (pers. comm.) describes that pine-lichen stands become less productive with age, and that lichen production is greatest when pine-lichen stands are at a younger age. Sulyma and Coxson (2001) found that the *Cladina* spp. of lichen is most prolific in lodgepole pine stands between 80 to 100 years of age. After 150 years, the moss forming stage becomes dominant and remains until a stand replacing fire resets the system (Sulyma and Coxson, 2001). If a stand is allowed to mature, and is not affected by natural fire disturbance or forestry activities, the pine stand becomes dominated by mosses, which reduce lichen availability and are of poor forage quality for caribou (Seip, pers. comm.).

Seip (pers. comm.) suggests that pine-lichen stands need to be managed as to ensure the highest production of lichens. Therefore, producing a management regime that rotates around an interval of 50-100 years, to continuously provide caribou habitat by maintaining younger pine stands. Coxson and Marsh (2001) suggest that natural thinning of stands older than 50 years creates enhanced growing conditions for *Cladonia* spp. lichens. Timber harvesting activities conducted during the winter months produced little harmful affects to the lichen community (Coxson and Marsh, 2001). If lichens are not disturbed during the harvesting process, the increased light penetration from a reduced canopy will enhance the already established lichen community (Coxson and Marsh, 2001). Strictly protecting pine-lichen stands would benefit caribou for the short term, but in the long term, the forest would become too mature and lose its lichen productivity (Seip, pers. comm.).

Brown et al. (2000) studied the relationships between lichen abundance and stand attributes in the Redwillow area of northeastern British Columbia. Lichen cover was highest in stands with tree heights less than 15 m, with crown closures less than 40%, and with stands less than 100 years of age (Brown et al., 2000). Overall, lichens were most abundant in pine and pine-

dominated stands that were 7 to17 m in height, which is below the harvest range of Canadian Forest Products (Brown et al., 2000).

It is becoming more apparent that in order to manage for caribou winter range within the Peace region, an extensive knowledge of how winter ranges differ between areas of the large management region, and being able to accommodate the differing requirements of each geographic area or selected herds will be required.

Table 5. Summary of northern ecotype Woodland Caribou winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Peace Foothills	1, 2, 23, 33, 39, 44			• Early winter: use low elevations • Late winter: use high elevation alpine • Used habitats between 1300-2000 m • Extensive use of alpine areas above 1300 m	Graham River caribou herd; elevation is largely determined by snow depths
Kiskatinaw Plateau	50			• Early winter: use low elevations • Late winter: use high elevation alpine	Caribou in this ecosection largely use the northern ecotype wintering strategy
Hart Foothills	31, 50	Slopes greater than 10° were not used during the winter	South and north aspects were used similarly throughout the winter	• May remain in high elevations or move to lower elevations • Used habitats below 1500 m	Caribou in this ecosection use a strategy that is a cross between mountain and northern ecotype wintering strategies
Northern Hart Ranges	50			Utilize low elevation forests, and move to higher elevations as snow depths become limiting	Kennedy-Siding caribou herd
Western Muskwa Ranges	16, 41, 47			• Use valley bottoms during early winter • Move to high elevations for late winter • Caribou used habitats between 1375-1850 m	Caribou from the Akie/Pesika River area winter in the Pink Mountain area
Front Ranges of Alberta	5, 6, 7, 13	Little use of slopes greater than 15% and preferred flat terrain	Little preference for aspect; south, east and west used most prominently	• Utilize low elevation forests as well as high elevation alpine • 60% of observations between 1351-1500 m • 16% between 1201-1350 m • 19% between 1501-1800 m	Winter ranges recognized in BC; Narraway River area
Hyland Plateau	14			High elevation alpine tundra utilized	Grayling River area
Kechika	24			• Early winter: use high elevation alpine tundra	Vents River area

Mountains				and the SWBmk2 BGC zone • Late winter: use low elevation forests	
Misinchinka Ranges	18			Use high elevation habitats	Caribou use a mountain ecotype strategy

2.6 Bison

Bison are only abundant in small, localized areas in the Peace River region. A population of plains bison (*Bison bison bison*) exists in the Sikanni Chief River/Pink Mountain area, while wood bison (*Bison bison athabascae*) reside north of the Liard River and in the Ring Border area along the BC-Alberta border (Elliot, pers. comm.; Woods, pers. comm.). Both sub-species have been introduced to northeastern British Columbia within the last 20 years (Woods, pers. comm.). Very little is known with regards to habitat use of this species, but because of their large size, bison are not as limited by cold weather or snow depths that are critical to other ungulates within the Peace region (Elliot, pers. comm.). Bison prefer flat terrain, but will use gentle to moderate slopes if forage is abundant and snow depths are not restrictive (Elliot, pers. comm.). Because of their large size, bison do not require thermal or security habitat, and therefore do not have specific winter cover requirements (Elliot, pers. comm.).

The primary limitation to bison is the quantity of forage that is required by these large animals (Churchill, pers. comm.; Elliot, pers. comm.). Bison are bulk feeders, requiring a large biomass of forage, but are not necessarily selective to certain species (Churchill, pers. comm.). However, palatability of forage is important. Churchill (pers. comm.) reports bison to significantly avoid *Calamagrostis canadensis* (bluejoint), possibly because of high silica content, decreasing the digestability of the species. Churchill (pers. comm.) describes that bison will walk through a cut block with a high biomass of vegetation, but will only eat selected species off the burn and slash piles located in the cut block. The high biomass of available forage was avoided primarily because of the non-palatable *Calamagrostis canadensis* that dominates post-disturbance sites.

Bison also appear to select for a certain quality of forage (specifically grasses). In the Sikanni Chief River and Halfway River areas, the subalpine habitats are highly productive and therefore are extensively used by bison (Churchill, pers. comm.). Winter diets are comprised of primarily sedges and grasses (Churchill, pers. comm.). A high biomass of forage is required for bison. In order to maintain a wood bison herd, a habitat must produce 2000 kg/Ha of forage (Churchill, pers. comm.). The most productive habitats, based on biomass production, include: wetlands and sedge fens (1300-3000 kg/Ha), aspen (500-1000 kg/Ha), timothy grassland (2000 kg/Ha) and wheatgrass (2200 kg/Ha) (Churchill, pers. comm.). These productive habitats require wet, nutrient rich soils. Churchill (pers. comm.) describes that bison are often associated with areas that have wet, nutrient rich soils. Specifically, within the Sikanni Chief River area, the sedge area of Marion Lake provides excellent bison habitat, and bison are consistently observed in the Marion Lake area throughout the winter (Churchill, pers. comm.). During the winter, because of increased snow depths, the alpine areas of Jessen Creek are wetter than surrounding areas, creating a high production of forage in this area. Bison often remain in these alpine areas, feeding on the high productivity grasses, until snow depths became too restrictive, forcing the bison to lower elevation areas. During the 2002-2003 winter, bison did not move down into river valleys because of little to no snow accumulation in alpine areas (Churchill, pers. comm.; Elliot, pers. comm.; Woods, pers. comm.). Snow depths in excess of 45 cm can be limiting to bison. When snow depths exceed this level, bison will move to areas of lower snow depths to forage (Churchill, pers. comm.).

Bison winter range can be defined as areas that support a high biomass and quality of forage, with snow depths less than 45 cm (Churchill, pers. comm.). Primarily, any area that does not

support *Calamagrostis canadensis* can be considered potential bison winter range (Churchill, pers. comm.). Due to the large biomass requirements, the connectivity of areas is a critical factor in maintaining and selecting bison winter range. In order to sustain a bison population, connectivity of forage areas is important. Bison will select first for habitats that supply large quantities of palatable grasses, secondly for large, connected forage areas, and finally for snow depths that are not restrictive (Churchill, pers. comm.). In the Peace region, good winter range areas for bison include the dry breaks of the Peace River and associated tributaries, large meadow complexes and wetland areas, such as Marion Lake (Churchill, pers. comm.). In addition, agricultural areas supporting domestic species provide excellent forage opportunities for wintering bison because of high palatability of the vegetative species (Churchill, pers. comm.).

In the Upper Liard, there is very little knowledge on how wood bison use the landscape. TEM projects in the La Biche and Sandy Creek area report bison congregating on islands in the Liard River during the winter because of lower snow depths (Madrone Consultants Ltd., 1998). In the Lower Liard and areas surrounding Fort Nelson, there are anecdotal reports of bison utilizing cut blocks during the winter (Elliot, pers. comm.). In the Snake/Sahtaneh region, habitat exploited by wood bison included riparian or floodplain zones (TerraMar Environmental Research, 1999). There is a need for increased knowledge of winter habitat use by bison in all areas of the Peace region (Elliot, pers. comm.).

Table 6. Summary of bison winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Hyland Plateau	45	Prefer flat terrain, but will utilize gentle to moderate slopes			
Sikanni Chief Upland					
Halfway Plateau					
Clear Hills					

2.7 Mountain Goat

Mountain goats are found throughout the Peace region, where topography and suitable habitat allow. Primarily, this includes the mountainous regions of northeastern BC. Winter range requirements for goats in the region are fairly general; however, very few studies have looked at goat habitat use specifically during the winter months (Wood, pers. comm.).

The most critical factor of goat winter range is the availability of escape terrain with sufficient forage quality and abundance (Woods, pers. comm.). However, goats are not highly selective on the type of forage that is used during the winter, and therefore, goats can use isolated patches of habitats, unlike Stone's sheep (Churchill, pers. comm.; Elliot, pers. comm.). Subalpine forests are used for forage during the winter, but it has not been determined if subalpine forests are selected for, or if they are utilized primarily because of their sole availability in higher elevations (Elliot, pers. comm.) Balsam fir has important forage qualities for mountain goats, but goats will use a wide variety of available vegetation including using tree wells to access exposed vegetation (Churchill, pers. comm.; Elliot, pers. comm.). Windswept slopes surrounding escape terrain will widely increase goat winter range by increasing movement away from the escape terrain (Churchill, pers. comm.). Steep, forested slopes are also ranked as potential winter areas for goats. Churchill (pers. comm.) describes that cover will not be avoided by goats, and will be used if it meets security requirements that are otherwise provided by steep cliffs and bluffs. In the Belcourt area, goats make use of steep, forested slopes for winter habitat (Churchill, pers. comm.; Woods, pers. comm.). Good goat winter range can generally be described as escape terrain in close proximity to subalpine forage (Elliot, pers. comm.).

In the Peace region, goat winter use of habitat has been described sporadically. In the Akie-Pesika River area, goats were observed in the subalpine and on alpine slopes and ridges of the Ospika River (Hatler, 1990). All goats south of the Peace Arm were observed on alpine ridges or timberline bluffs or ridges, adjacent to escape terrain (Backmeyer, 1991). During an ungulate survey in the Misinchinka Ranges, goats were observed wintering on windblown slopes and rocky terrain with south or west aspects (Hengeveld and Wood, 1998). The majority of goats observed south of the Peace Arm were located between Carbon Creek and Clearwater Creek at elevations greater than 1500 m (Backmeyer, 1991). Northeast of the Finlay Reach, goats were observed on steep rocky terrain with south to west aspects (Wood, 1994). In the Prophet River area, goats were observed using bluffs adjacent to heavy forested areas (Poole and Fear, 1998). Within the Prophet River area, there are localized populations of goats inhabiting the cliffs along the lower sections of the Buckinghorse and Sikanni Chief Rivers (Poole and Fear, 1998). In the Besa-Prophet area, goats were observed in alpine areas and in the SWBmk, in association with adjacent escape terrain (R.A. Sims and Associates, 1999).

Table 7. Summary of mountain goat winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Front Ranges	43, 53	Steep slopes required for winter habitat			Belcourt River area
Misinchinka Ranges	1, 18		South and/or west aspects used	Observed at elevations greater than 1500 m	Majority of goats observed were located between Carbon Creek and Clearwater Creek
Western Muskwa Ranges	38	Steep terrain used	South to west aspects used		Observations made northeast of the Finlay Reach

2.8 Stone's Sheep

Stone's sheep in the Peace region appear to have three different wintering strategies (Wood, pers. comm.). These strategies include the typical high elevation winter areas in alpine habitats, a mid-elevation winter range that include complexes of cliffs or bluffs in close proximity to grassland areas, and finally lower elevation areas that include the use of forested habitats in addition to the grassland/cliff complexes (Culling, pers. comm.; Elliot, pers. comm.; Wood, pers. comm.; Woods, pers. comm.). Sheep using the low elevation winter strategy occur only in the Williston Reservoir area, specifically along the north shore of the Peace Arm (Culling, pers. comm.; Elliot, pers. comm.).

The winter season is the limiting factor on sheep populations in northeastern BC because of what is required by sheep to survive through the winter. Winter habitat required by sheep includes escape terrain in the form of cliffs or rocks bluffs that are adjacent to quality forage areas (Elliot, pers. comm.; Woods, pers. comm.). However, there are not a lot of habitats that support both escape terrain and sufficient forage (Elliot, pers. comm.). If these two elements of winter range are not met, sheep cannot survive through the winter successfully. Sheep need to be able to leave escape terrain to forage, but if forage areas are too far away from escape habitat, sheep become more susceptible to death by predation (Elliot, pers. comm.). Unlike mountain goats, sheep cannot utilize isolated patches of habitats, but instead they require a continuity of habitats that support both escape terrain and forage to meet the selective foraging needs of Stone's sheep (Churchill, pers. comm.).

Forage quality and availability appear to be important factors in winter survival of sheep. Wood (pers. comm.) discusses that 5 of 18 monitored sheep in the Williston Reservoir area died of starvation in the winter of 2002. Luckhurst (1973) studied the importance of plant communities to Stone's sheep in the Nevis Creek area, concluding that sheep depend exclusively on exposed, alpine vegetation through the winter. Three plant communities had heavy use and reliance on by sheep throughout the winter. Sheep heavily favoured *Elymus-Agropyron* communities on south aspect slopes more than any other alpine plant community (Luckhurst, 1973). This plant community was rarely used during the summer, but was used extensively during the spring, because of quick green-up, and during the winter. However, *Elymus-Agropyron* communities represented only 20% of the winter range area. Sheep also selected *Elymus-Festuca* and *Dryas-Festuca* plant communities during the winter. Both communities were predominantly used on south to west aspects and on windswept ridges (Luckhurst, 1973). Species in the *Elymus-Agropyron* community, buried under 4 feet of snow, were selected for over non-buried shrubs and Arctic lupine (Luckhurst, 1973). Species important as winter forage for sheep include grasses, *Festuca scabrella* and shrubs during the fall season; however, shrub used declined from 20% in the fall to only 2% use in the winter (Luckhurst, 1973).

Corbould (1998) supports the dominance of grass in winter diets of sheep. Across three different collection sites along the north shore of the Peace Arm, sheep used vegetation species in different proportions, varying by site (Corbould, 1998). Samples collected from Rainbow Rocks had a high proportion of graminoid content (77%) and lower abundance of shrubs and forbs (14% and 6%, respectively). In the Nabesche River area, sheep pellets had only 12% grasses, but had higher proportions of forbs and mosses (50% and 25%, respectively). In the Butler

Ridge area, terrestrial lichens were the dominant species identified in the collected samples (43%), and grasses made up only 18% of the sample. Corbould (1998) suggests these results indicate that sheep select their habitat by what is available.

Similar to other small ungulates in the Peace region, sheep distribution and habitat use is affected by snow accumulation (Luckhurst, 1973; Wood, pers. comm.). Summer ranges are usually in high elevation areas, and movement to low elevation winter ranges is stimulated by accumulating snow depths (Wood, pers. comm.). Luckhurst (1973) also reported this migration in response to snow depths in the Nevis Creek area. With snow accumulating during the fall, sheep moved down to lower alpine slopes, with south or west aspects. As wind action created more windswept slopes, sheep moved back up to higher elevation slopes and ridges, using the sparse, but exposed vegetation in these areas. Sheep in the Nevis Creek are spent much of the winter on south to west aspect, windswept slopes at elevations below 1737 m (Luckhurst, 1973). Exposed sunny and windswept slopes represented only 20% of productive sheep habitat, but these habitats were used extensively during unfavourable snow conditions (Luckhurst, 1973).

Sheep winter habitat use throughout the Peace region has been briefly described. In the northern mountains, sheep winter in the windswept alpine areas where forage and escape terrain are available (Elliot, pers. comm.). In the Yedhe, Delano and Racing River areas, (Seip, 1983; cited in Westworth Associates Environmental Ltd., 1998) sheep utilized windswept peaks and ridges at elevation between 1500 to 2000 m. In southern parts of the region, sheep utilize any one of the three wintering strategies discussed above. The Branham cliffs, between 1000 to 1300 m in elevation, are used by wintering sheep for the presence of cliffs adjacent to forest cover and grassland habitats (Wood, pers. comm.). Lower elevations along the Williston Reservoir lake shore, between 600 to 900 m in elevation, are used in areas were steep terrain and grassland slopes are present, primarily between Schooler Creek to Dunlevy Creek (Culling, pers. comm.; Wood, pers. comm.). High elevation alpine habitats are used along Butler Ridge, Aylard Ridge and Upper Schooler Creek (Wood, pers. comm.). Sheep transplanted to areas south of the Peace Arm, from Mt. Brewster and Kobes Creek, showed a large use of rocks (65%) and alpine/subalpine (30%) habitat use during the winter (Backmeyer, 2000b). Individuals from the source herd of this transplant project used a combination of shrub/grass habitats, alpine/subalpine habitats and conifer bluffs throughout the winter (Backmeyer, 2000b).

Sheep rely on the presence of grasslands on south facing aspects for winter forage. Prescribed burns have been used in the past to enhance sheep winter range by providing forage areas. Seip (pers. comm.) describes, however, that the placement of burns in relation to topography is critical to the success of the prescribed burn. Prescribed burns completed in the early 1980's near Toad River were not effective in producing viable sheep winter range areas. These burns were not placed according to topography, and subsequently were not used by wintering sheep. Seip (pers. comm.) suggests prescribed burns should be placed adjacent to areas that supply escape terrain for sheep. Along the north shore of the Williston Reservoir, prescribed burning has been conducted for the purpose of enhancing elk winter range. This burning benefits sheep foraging, but may also be detrimental to sheep because they can be subjected to competition from elk for shared forage. Culling (pers. comm.) suggests prescribed burns should be done specifically for sheep in areas with sufficient security habitat; otherwise elk expand their range into valuable sheep foraging areas. Churchill (pers. comm.) suggests habitats supporting steep, grassland

slopes should be managed for sheep foraging, regardless of their proximity to escape terrain; thus supporting higher sheep populations during less severe winters.

Table 8. Summary of Stone's sheep winter habitat descriptions by ecosection within the Peace River region.

ECOSECTION	REFERENCES	SLOPE	ASPECT	ELEVATION	COMMENTS
Muskwa Foothills	22		Used south or west aspects	• Early winter: moved to low elevation areas • Late winter: moved up to higher elevations • Most of winter spent at elevations below 1737 m	Nevis Creek area
Eastern Muskwa ranges	37			Utilized elevations between 1500-2000 m	Yedhe, Delano and Racing River area
Peace Foothills	33, 44, 52			Elevations between 1000-1300 m used; also used elevations from 600-900 m along shore of Williston Reservoir	Branham Cliffs; Schooler Creek to Dunlevy Creek

3.0 CURRENT AND FUTURE PROJECTS

There are a number of current and proposed future projects that will be of importance to designation of ungulate winter range within the Peace region upon their completion. The projects listed in Table 9 will provide valuable biological data specific to the Peace region to supplement the lack of a reliable database of scientific data on ungulate winter range and habitat use.

4.0 SUMMARY

The purpose of this project was to identify how ungulates within the Peace River region utilize habitats during the winter months and to identify how habitat use is different throughout the region. It is important to recognize that the amount of reliable, scientific data that has been collected for ungulate winter habitat use is very minimal and that anecdotal information is relied upon for many management decisions. Accurate designation of ungulate winter range requires extensive research on animals and habitats specific to the Peace region, to reliably describe winter range use.

Table 9. Current and future projects that will provide local biological data to the process of designating ungulate winter range.

COORDINATOR	PROJECT	DATES	AREA and SPECIES	STUDY DESCRIPTION
Peace/Williston Fish and Wildlife Compensation Program – Mari Wood	20 Mile Point Stone's Sheep Project	Completed March 2003	Butler Ridge to Nabesche River	• Determine if Stone's sheep were invested with winter ticks and the effects of these ticks • Involved the radio-collaring and year-round monitoring of Stone's sheep
Peace/Williston Fish and Wildlife Compensation Program – Mari Wood	Peace Arm Stone's Sheep Population Dynamics	3 year program to be initiated in 2004-2005	Peace Arm Stone's Sheep population	• Determine rates and causes of mortality of lambs • Determine habitat use, movements and causes of mortality in rams
Pacific Slope Consulting, for Slocan Forest Products, Mackenzie – Scott McNay	Omineca Northern Caribou Project	Initiated in 1998, Year 4 completed in 2002	Caribou, moose and wolves in the Omineca region (Mackenzie TSA)	• Goal to determine the impacts of forest harvesting on caribou habitat use • Predator-prey relationships between moose, caribou and wolves • Currently have both VHF and GPS collars on animals within the study area
Diversified Environmental Services, for Sloan Forest Products, Fort Nelson – Brad Culling	Boreal caribou study	Study on-going; subject to continued funding	Boreal caribou in areas surrounding Fort Nelson	• Determine habitat use and movements of boreal caribou • Using GPS collars on 18-20 animals
Ministry of Water, Land and Air Protection and University of Northern British Columbia – Katherine Parker	MK Habitat Modeling	Initiated in 2001; Data will be available within one to three years from present (2004-2006)	Stone's sheep, caribou and moose within the Besa-Prophet area	• Determine habitat use and movements of all three species • GPS collars have been fitted to all three species and will provide detailed year-round data on habitat use
Ministry of Water, Land and Air Protection – John Elliot and Robert Woods	Elk and Caribou Monitoring	Initiated in February 2001 (elk) and January 2001 and July 2000 (caribou); study on-going subject to continued funding	Caribou and elk within the Kechika River area	• Determine habitat use of elk and caribou in the Kechika River area • Using VHF collars to obtain habitat locations

5.0 REFERENCES

1. Backmeyer, R.J. 1991. Wildlife distribution and habitat use south of the Peace Reach of Williston Reservoir, February 1991. Peace/Williston Fish and Wildlife Compensation Program Report No. 7. 19pp.
2. Backmeyer, R.J. 2000a. Seasonal habitat use and movements of woodland caribou in the Graham River drainage (1988-1994). Peace/Williston Fish and Wildlife Compensation Program Report No. 225. 17 pp plus appendices.
3. Backmeyer, R.J. 2000b. Seasonal habitat use and movements of transplanted and source herd Stone's sheep, Peace Arm of Williston Reservoir (1990-1994). Peace/Williston Fish and Wildlife Compensation Program Report No. 226. 21 pp plus appendices.
4. Backmeyer, R.J. 2000c. Habitat use and movements of Rocky Mountain elk on the Peace Arm of Williston Reservoir (1991-1994). Peace/Williston Fish and Wildlife Compensation Program Report No. 224. 19 pp plus appendices.
5. Benn, B. and M. Bloomfield. 1981. Description of the winter activities of caribou in the Prairie Creek area. Alberta Energy and Natural Resources, Fish and Wildlife Division, Edson, AB.
6. Bloomfield, M., J. Edmonds, and J. Steele. 1981. First annual report of the Berland-A La Peche caribou study. Alberta Energy and Natural Resources, Fish and Wildlife Division, Edson, AB.
7. Brown, W.K. and D.P. Hobson. 1998. Caribou in west-central Alberta – information review and synthesis. Prepared by Terrestrial and Aquatic Environmental Managers Ltd., Calgary, AB, for The Research Subcommittee of the West-central Alberta Caribou Standing Committee.
8. Brown, W.K., J.L. Kansas, and L.R. Linton. 2000. Predicting terrestrial lichen occurrence in the Redwillow Landscape Unit, northeastern British Columbia. Prepared by Terrestrial and Aquatic Environmental Managers Ltd., Calgary, AB, for Canadian Forest Products Ltd., Chetwynd, BC.
9. Churchill, B. 2002. Draft boreal caribou account. Unpublished report.
10. Corbould, F.B. 1998. Winter diets of Stone's sheep, Rocky Mountain elk and mule deer: Peace Arm and Ospika River drainages. Peace/Williston Fish and Wildlife Compensation Program, Report No. 182. 18pp plus appendices.
11. Coxson, D.S. and J. Marsh. 2001. Lichen chronosequences (postfire and postharvest) in lodgepole pine (*Pinus contorta*) forest of northern interior British Columbia. Canadian Journal of Botany 79: 1449-1464.
12. Culling, D.E. and B.A. Culling. 2001. A literature review of the ecology and habitat requirements of wildlife species in the Graham River watershed. Prepared by Diversified Environmental Services, Fort St. John, BC, for Canadian Forest Products Ltd., Fort St. John/Taylor Division, Fort St. John, BC.
13. Edmonds, E.J. and M. Bloomfield. 1984. A study of woodland caribou (*Rangifer tarandus caribou*) in west central Alberta, 1979 to 1983. Fish and Wildlife Division, Alberta Energy and Natural Resources.
14. Goulet, L.A. and D.J. Haddow. 1985. An inventory of wildlife resources on the Liard River, northern British Columbia: a report of the 1978, 1980, and 1981 field studies. BC Hydro. Report No. Ess-30.
15. Hatler, D.F. 1989. Moose winter distribution and habitat use in the southern Williston

Reservoir area, British Columbia, 1989. Peace/Williston Fish and Wildlife Compensation Program Report No. 1. 25 pp. plus appendices.
16. Hatler, D.F. 1990. Wildlife distribution and habitat use in the northern Williston Reservoir area, British Columbia, winter 1990. Peace/Williston Fish and Wildlife Compensation Program Report No. 3. 17 pp plus appendices.
17. Hengeveld, P.E. and F.B. Corbould. 2000. Winter moose surveys of the Omineca, Nation, and Ospika River drainages, 1999. Peace/Williston Fish and Wildlife Compensation Program Report No. 232. 19pp plus appendices.
18. Hengeveld, P.E. and M.D. Wood. 1998. Misinchinka Ranges winter ungulate inventory, March 1996. Peace/Williston Fish and Wildlife Compensation Program Report No. 175. 19 pp plus appendices.
19. Hengeveld, P.E. and M.D. Wood. 2001. Survey of Rocky Mountain Elk along the Peace Arm of Williston Reservoir, North-Eastern BC, February 2000. Peace Williston Fish and Wildlife Compensation Program Report No. 251. 12 pp plus appendices.
20. Hirst, S.M. 1990. Ungulate census of north shore and adjacent areas, Peace Arm, Williston Reservoir, March 1989. Peace/Williston Fish and Wildlife Compensation Program Report No. 2. 10 pp plus appendices.
21. Hornbeck, G.E. and D.L.J. Moyles. 1995. Ecological aspects of woodland caribou in the Pedigree area of northwestern Alberta. Report by Axys Environmental Consulting Ltd., Calgary, Alberta, and Alberta Environmental Protection, Natural Resources Services, Peace River, Alberta, for the Pedigree Caribou Standing Committee (Wascana Energy Inc., Nova Corporation of Alberta, and Canadian Hunter Exploration). 66 pp.
22. Luckhurst, A.J. 1973. Stone sheep and their habitat in the northern Rocky Mountain foothills of British Columbia. A Master of Science Thesis, In the department of Plant Science, the University of British Columbia.
23. McNay, R. S., J. B. Joy, and L. Giguere. 1999. Ecological Factors Affecting Northern Caribou in the Omineca Region, British Columbia. Year 1 (1998) Inventory Results. Unpubl. Report, Forest Renewal B.C., Prince George Region, Prince George, British Columbia.
37 pp.
24. Norecol Dames and Moore Ltd. 1998. Wildlife models and suitability ratings table for Smith/Vents Rivers terrestrial ecosystem mapping project. Prepared for Slocan Forest Products Ltd., Fort Nelson, BC.
25. Peck, V.R. 1987. Responses of elk and vegetation to prescribed fire in the Tuchodi River area of northeastern British Columbia. A Master of Science Thesis, In the department of Wildlife Resources, the University of Idaho.
26. Poole, K.G. and D.A. Fear. 1998. Mountain goats and Stone's sheep in the Buckinghorse, Sikanni Chief, and Boat drainages, Prophet River Territory. Prepared by Timberland Consultants Ltd. For Prophet River Indian Band. Fort Nelson, BC. 22 pp.
27. R.A. Sims and Associates. 1999. Terrestrial ecosystem mapping (TEM) with wildlife habitat interpretations of the Besa-Prophet Area, Part 2: Wildlife Report. Prepared by R.A. Sims and Associates, Vancouver, BC, for BC Environment, Lands and Parks, Fort St. John, BC.
28. Resource Inventory Committee (RIC). 1998. Field manual for describing terrestrial

ecosystems. Land Management Handbook No. 25, British Columbia Ministry of Environment, Lands and Parks and Ministry of Forests, Victoria, BC.
29. Resources Inventory Committee (RIC). 1999. British Columbia wildlife habitat ratings standards. Version 2.0. BC Ministry of Environment, Lands and Parks, Victoria, BC.
30. Silver, R.S. 1976. Ecological features of moose (*Alces alces andersoni*) winter habitat in the boreal white and black spruce zone of northeastern British Columbia. M.Sc. thesis, In the Department of Plant Science, University of British Columbia, Vancouver, BC.
31. Sopuck, L.G. 1985. Movements and distribution of caribou in relation to the Quintette Coal Development. Prepared by Renewable Resources Consulting Services Ltd., for Denison Mines Ltd., Sidney, BC. 50 pp.
32. Sulyma, R. and D.S. Coxson. 2001. Microsite displacement of terrestrial lichens by feather moss mats in late seral pine-lichen woodlands of north-central British Columbia. The Bryologist 104: 505-516.
33. TERA Environmental Consultants Ltd. 1995a. PCP Falls Bickford wildlife surveys, January and February, 1995. Prepared by TERA Environmental Consultants (Alta.) Ltd., Calgary, AB, for Talisman Energy Inc.
34. TERA Environmental Consultants Ltd. 1995b. Winter 1994/1995 large mammal survey Mt. Bickford area, N.E. British Columbia. Prepared by TERA Environmental Consultants (Alta.) Ltd., Calgary, AB, for Talisman Energy Inc.
35. TerraMar Environmental Research Ltd. 1999. Snake/Sahtaneh terrestrial ecosystem mapping inventory. Prepared by TerraMar Environmental Research Ltd.
36. Teversham, J., L.Veach and D. Becker. 1998. Ecosystem mapping and wildlife interpretations for the La Biche and Sandy Creek areas of northeastern British Columbia. Prepared by Madrone Consultants, Duncan, BC, for Slocan Forest Products Ltd., Fort Nelson, BC.
37. Westworth Associates Environmental Ltd. 1998. Wildlife inventories in the Burnt River Landscape Unit: Volume 2 – Terrestrial furbearers, carnivores, and ungulates. Prepared by Westworth Associates Environmental Ltd., Edmonton, AB., for Canadian Forest Products Ltd., Chetwynd Division, Chetwynd, BC.
38. Wood, M.D. 1994. Muskwa Range (east of Finlay River) winter ungulate inventory, March 1994. Peace/Williston Fish and Wildlife Compensation Program Report No. 32. 6 pp.
39. Wood, M.D. 1996. Seasonal habitat use and movements of woodland caribou in the Omineca Mountains, north central British Columbia, 1991-1993. *Rangifer*, Special Issue No. 9: 365-378.
40. Wood, M.D. 2002. Summer inventory of mountain goats and Stone's sheep in the Nabesche River drainage, north-eastern British Columbia, 1998. Peace/Williston Fish and Wildlife Compensation Program Report No. 265. 14 pp. plus appendices.
41. Zimmerman, K. L., R. S. McNay, J. B. Joy, and L. Giguere. 2001. Ecological factors affecting northern caribou in the Omineca Region, British Columbia. Year 3 (2000) Inventory Results. Unpubl. Report, Forest Renewal B.C., Prince George Region, Prince George, British Columbia. 95 pp.

6.0 PERSONAL COMMUNICATIONS

42. Backmeyer, Rod. 2003. Ecosystem Biologist, Ministry of Water, Land and Air Protection, Fort St. John, BC.
43. Churchill, Brian. 2003. Wildlife Biologist, Chillborne Environmental, Fort St. John, BC (formerly of Ministry of Environment, Lands and Parks).
44. Culling, Brad. 2003. Biologist, Diversified Environmental Services, Fort St. John, BC.
45. Elliot, John. 2003. Wildlife Biologist, Ministry of Water, Land and Air Protection, Fort St. John, BC.
46. Gustine, Dave. 2003. Graduate Student, University of Northern British Columbia, Prince George, BC.
47. McNay, Scott. 2003. Wildlife Biologist, Slocan Forest Products, Mackenzie, BC.
48. Parker, Katherine. 2003. Associate Professor, University of Northern British Columbia, Prince George, BC.
49. Peck, Ross. 2003. Wildlife Biologist, Area Resident and Guide Outfitter, Fort St. John, BC.
50. Seip, Dale. 2003. Research Biologist, Forest Service, Prince George, BC.
51. Webster, Bryan. 2003. Wildlife Biologist, Ministry of Water, Land and Air Protection, Fort St. John, BC.
52. Wood, Mari. 2003. Senior Wildlife Biologist, Peace/Williston Fish and Wildlife Compensation Program, Prince George, BC.
53. Woods, Robert. 2003. Wildlife Technician, Ministry of Water, Land and Air Protection, Fort St. John, BC.

7.0 APPENDIX – INTERVIEW SUMMARIES

1.1 Bryan Webster – February 2003

Elk:
- Arnell Mountain to big bend of Gatho Creek
    - Elk will stay on grassy slopes
    - No cover in the area
    - With very deep snow, elk will move to timber
- Moberly is important for elk

Caribou:
- Dunedin watershed
- Minnaker Valley
- Mountain north of the Besa River

Moose:
- bison and moose compete for resources
- bison pushing moose out of the bison's niche
    - bison have established a niche
- area between Halfway and Sikanni is one of the best moose habitats in the Peace Region
- all habitats in the Peace region are used by moose during the winter
- hard to specify which areas more important than others
- ***look at aerial photos or seismic/logging maps over the past 30 years to determine the amount and rate of change over the landscape
    - ie: Hackney Hills to Klingzut Mountain
    - would provide good support as to how quickly things are changing and the need to preserve some areas for ungulate habitat
    - overlay data from 1975 up unto present
- Iron Creek area important moose habitat
- From Mile 95 to Mile 148, bordered by the Halfway to the highway – critical moose habitat

1.2 Rob Woods – February 2003

Mule Deer:
- Pine River, Peace River, Moberly River, halfway River and Beatton Valley
- All the river breaks with south aspects are most important
- Mule deer are very dependent on the amount of snow with each year
- Slope and elevation selection depend on snow conditions
- Habitat selection for winter range also depends on crop status and availability of crops (snow depths)
- Golata Creek, Alces Creek, Cache Creek southern breaks

White-tailed Deer:
- no idea
- no predictable winter habitat within the Peace Region

Elk:

- have no preference for slope or elevation
- burned areas are very important to elk winter habitat
- Pine River, Moberly River, Murray River, and Wapati River southern breaks are important
- Mountain elk use Williston Lake, Peace River and Halfway River southern breaks are important
- Areas in the Graham where prescribe burns have been done
- Tuchodi and Gatho Creek areas are very important – burned areas
    - Lots of hills where they winter on all aspects depending on snow depths in each year

Stone's Sheep:

- there is data available from last year's aerial surveys that were done by Rob
    - have latitude and longitude locations
- elevation:
    - some sheep move low down (Williston Lake sheep move down to the lake)
    - can be in the 4000-6000 foot range

Mountain Goats:

- escape terrain is most critical factor for goats
    - escape terrain needs to be coupled with conifer stands or wind-swept areas
- need good vegetation to have good habitat
- elevation:
    - Belcourt, Sikanni and Trutch populations use lower elevations
    - Elevation does not seem to be important….everything depends on availability of escape terrain

Caribou:

- windswept ridges
- subalpine habitats are used, but will drop to black spruce and white spruce and pine flats
    - ie: other side of the highway
- south of Dawson Creek, find caribou in mid-age pine stands during the winter
- aspect, snow depth and escape terrain are most important variables
- will only come down as far as the snow pushes them

Moose:

- Nevis valley important moose habitat

1.3 Brian Churchill – March 2003

Mule Deer:

- provincial standards apply to mule deer in the Peace Region
- steep slopes, low snow depth and adjacent cover

Moose:

- standards apply to high productivity
- low snow or high productivity will be the driving factor behind habitat selection
    - will take high productivity over low snow
    - are happy to sit up to their waists in snow and eat
    - red-osier dogwood is a high productivity food
- productivity is the primary habitat determinant

- will sacrifice movement for productivity
- important habitat areas in the Peace
    - riparian benches
    - wetland associated complexes
        - ex: Watson's Slough
    - hummocky ground
    - mixes of shrub
    - burns in winter are good, but turn bad with increasing temperatures
- elevation
    - do well below 3000 ft
    - do well above 4500 ft where areas are snow free
    - snowbelt in between these areas is not as good
    - sublalpine and valley bottoms
- winter in the BWBS almost anywhere where there is available food
- ESSF – poor because of high snow depths
- Habitat capability mapping is good for Peace Lowlands
    - Maybe not as good for subalpine areas

White-tailed Deer:

- cover is the primary concern for white-tailed deer
    - mixed cover is best; deciduous is better than coniferous
- if have cover, then will look for areas with forage
    - forage is contingent with snow depth
- low snow with cover and forage is key
    - ie: benches on the Peace
- separation between white-tailed and mule deer
- have some limits on snow
- tops and toes of slopes are focus areas
    - riparian areas used a little, but not as much in the Peace Region as they are in other regions of the province
- require patches of cover greater than 40 acres of forest cover
- openings are used for feeding
- never far from cover
- require cover for thermoregulatory reasons
    - because white-tails are smaller than mule deer, they have a higher surface area to volume ratio and lose heat quickly
    - therefore requiring cover for thermal reasons

Elk:

- grass eaters
    - low snow areas
    - can crater from 12-18 inches
    - after 40 cm cannot crater
        - therefore, need south facing slopes
- other food stuffs make up a small proportion of diet
- cover requirements are based on the amount of disturbance in an area
    - with disturbance, elk require cover and willr emain in cover until disturbance has passed

    - responded to disturbance within 3 km of elk
    - moved to cover
    - cover properties are for security cover, not thermal cover
- cover requirements are not needed for thermal, unless temperatures are very cold
    - non-continuous cover is quite useful for elk and white-tailed deer
        - has thermal and security qualities
- farmers fields and agricultural areas in Peace Lowlands are being used more extensively by elk
    - because of the high grass production
    - however, will only see them at night because of reduced disturbance at this time
- elevation
    - elevation is critical with regards to snow depths
    - snow depths limit distribution

Stone's Sheep:

- windswept slopes within 0.5 to 1 km of escape terrain
- require continuity
    - cannot have isolated patches
    - therefore, do not see many sheep in the Graham River area
- with no predation and no bad winters, get a build-up of sheep population
- however, one bad winter, and the population is driven back down to what the habitat can support
- need to take a conservative approach to habitat management
    - manage all steep, grassy areas regardless of how close they are to escape terrain

Mountain Goats:

- unlike sheep, goats will use isolated patches
- rely on standing in escape terrain where predators cannot reach them, within close distance to forage areas
- not highly selective for forage
- Balsam fir is relied on for forage, but will eat a lot of different vegetation
- Windswept slopes will expand the goat's range
- Escape terrain is the primary habitat key
- Mt. Robert and Murray River Area
- Important habitat qualities
    - Windswept alpine with balsam shrubs
    - Steep areas in trees
        - Ex: Belcout and Boot Creek goats
    - Won't avoid cover, will use it if it suits needs

Caribou:

- all caribou depend on dispersal for predator avoidance
- mountain caribou = require ground forage
    - move around in timber where they can easily disperse if required
    - move down to low elevation forests where they can forage
    - mature pine stands with lichen cover on ground
    - Quintette caribou
        - Moved out to Kiskatinaw burn
        - Area has good snow and undisturbed

    - Need forage and be able to disperse – therefore open forest types are important
- caribou ecotypes differ by density of groups and feeding types
- Janet Edmonds – Grande Cache caribou (comparable to Peace region)
    - Used lots of wetlands and adjacent forests
    - Lots of sedges and shrubs are utilized
- Boreal caribou
    - Wander in open pine and black spruce types
    - Open stands provide more forage
    - Forage on anything edible
        - Are not choosing habitat for forage qualities, but rather choosing habitat for dispersal ability it offers
    - Not a lot of lichens in these forest types
    - Will also go to high elevation, wind swept areas
    - Avoid forest types
        - Get lost in the peatlands
        - Get into mixed predator areas when in forested areas
- Require connectivity
- Predation is key
- Early winter:
    - Find north facing open slopes in subalpine
        - Steep, black spruce
        - SWB
        - Way of isolating themselves
    - Caribou move well in snow, but won't crater in deep snow
    - Peace area does not produce high quality lichen

Bison:

- bulk feeders
    - not specific to what, but eat lots
    - obliterate grasses
- one grass that is avoided is Calamagrostis – blue-joint
    - possibly has lots of silica in it, making it hard to digest
- can define bison areas by non-Calamagrostis areas
- require certain quality of grasses
    - subalpine of Sikanni and Halfway because of high productivity
    - grasses need to be palatable
- some snow dependence
    - tolerant to 45 cm
- big connected meadows with high production of grasses
- west of Nevis Creek, alpine is wetter because of deeper snow, so very productive
    - ex: Jessen creek
    - but, the snow depths exceed 40-50 cm, and the bison move out of the area and into Hammetts ranch and area
    - this year, the bison were not forced down to lower elevation because of the little snowfall, so remained in the high productivity areas
    - snow dependent
- primary – high productive grasses that are palatable

- second - big forage areas
- third - low snow depths
- poor winter range:
    - forested areas that would produce Calamagrostis
- good winter range:
    - dry breaks of Peace Breaks are good
    - domestic species are very palatable
    - east of Butler Ridge, dominated by Calamagrostis
    - ends of Marion Lake are great bison habitat
- need lots of food
- eat off burn/slash piles, while walking through waist high grass in logged areas (avoid the non-palatable Calamagrostis)
- why aren't they moving north?
    - Maybe because of a change in grass composition
- Winter diet = sedges and grasses
- High digestive efficiency for lower protein foods
- High biomass wet meadows are good
- Slough sedge, Carex, Anthroides
- For wood bison – need a habitat that can produce 2000 kg/ha of forage to support bison
- Most productive:
    - Wetlands and sedge fens – 1300-3000
    - Aspen – 500-
    - Tamarack/black spruce
    - Timothy, grassland – 2000
    - Wheatgrass – 2200
- Wet nutrient rich soils
- Connectivity of areas – large connected units to sustain bison

1.4 Dale Seip – March 2003

Currently monitoring 4 herds of caribou:

1. kennedy/siding herd
    a. strictly use the pine-lichen flats
    b. remain in pine-lichen clearcuts and open areas, until snow becomes restricting for cratering and limits lichen availability
    c. then move into pine-lichen forests, remain there until snow depths are limiting
    d. move up into the subalpine forest
    e. move up into the windswept alpine
2. Moberly herd
    a. Remain in alpine or subalpine year round
3. group west of Tumbler Ridge
    a. remain in windswept alpine all winter
4. group in Quintette area?
    a. will move out of mountains and into the pine-lichen stands to the west for winter habitat

northern ecotype – generally the windswept alpine areas are most important
- however, if pine-lichen stands are available, these can also be used
- all caribou on the east side of the trench below Dawson Creek, tend to follow the same regime:
    - summer in the BC mountains, and move out to abundant pine-lichen flats for the winter
- however, when move farther north, there seems to be a mix of winter movements that occur
    - some remain in windswept alpine all winter, and some move out to pine-lichen stands
- as soon as you cross the ride onto the leeward side of the mountains, the wintering regime of caribou changes from mountain ecotype to a mix of northern and mountain ecotype
- not sure why the caribou stay within the windswept alpine throughout the winter
    - forage quality is very bad

pine-lichen stands in northeastern BC
- not very abundant
- not very good quality
- studies have shown that the pine-lichen stands are most productive with lichen when at much younger age stands, and that if a disturbance regime does not go through, the stand will become too mature, and be dominated by mosses, which are very poor forage habitat for caribou
- need to manage these stands to keep them young and highly productive with terrestrial lichens, before they become too old
    - mature stands become unproductive caribou habitat greater than 50-100 years
    - produce a management regime that rotates around this interval to continuously provide caribou habitat
    - a sole conservation area of caribou winter range would not be beneficial for the long term protection of caribou habitat, as these pine-lichen stands will over mature, and will not be used by caribou

mountain caribou – remain high elevation, ESSF forests that are extremely productive with arboreal lichens
- however, there is a big limitation on the energetics of the caribou, because of the extreme snow depths within these areas
- extreme snow depths prevent predators from entering the area
- suggested that the mountain ecotype is a last resort choice of strategy
    - if pine-lichen stands are available, these will be used
        - example: in the Kootneys, there was a bench that was burnt at one point, and the caribou wintered in this area
    - but because of the climate and forest structure of the central interior, mountain ecotype strategy must be chosen
- management of the mountain ecotype includes protecting these high producing arboreal lichen forests, and because they mature more and produce more lichens, they will satisfy caribou requirements for a long term

Stone's Sheep:
- Dale did his PhD on stone sheep forage quality in the Toad River
- found that the burns that were done in the early 1980's were not burnt according to correct topography, and provided little winter forage for the sheep
- found that the sheep would not use these burns, probably because of the topography of the slopes burnt

1.5 Ross Peck – March 2003

Elk:
- are generalist feeders
- will browse if required too, but generally prefer the south facing slopes because of low snow depths
- primary winter range is in the Tuchodi, Gatho, Sikanni and Muskwa areas
- areas around fort nelson tend to support elk in the winter, but in low numbers
    - often are associated with slash logged areas and river breaks
    - these few elk that winter in these areas are probably pushed out of prime winter range by high numbers of elk
    - they are able to survive on these secondary winter ranges because of favourable climate occurring in the past decades
        - if climate were to change and a hard, cold winter with greater snow depths was experienced, elk numbers would likely deplete to a number that the primary winter range areas are able to support, weeding out of elk in secondary winter range areas that are made available through favourable climate
- some elk are migratory
    - other are not
    - even within the same herd, will get some that remain in a very small area throughout the entire year
    - others will migrate long distances
- a number of the elk in the Fort Nelson area used to move back to the Tuchodi to winter
    - but some would remain in the slash areas of Fort Nelson
- prescribe burns definitely increase elk numbers and help them to withstand wolf predation
- Ross believes that the elk are what is supporting the wolf population currently
- elk are able to make use of farmers fields and agricultural development because the forage is there
    - however, they are secretive about it
- elk compete with sheep winter range in higher elevations
- elk compete with moose in browse situations as well

1.6 Brad Culling – March 2003

Boreal Caribou:
- Slocan has approximately 18-20 caribou GPS collared and monitored over the past 3 years in the Fort Nelson area

- Wintering strategy:
    - Never go to the mountains to winter, remain in swamps
    - Stay in strictly black spruce and sphagnum wetlands
    - Switch between arboreal and boreal lichens depending on snow depths
    - Stay in wetland complexes
    - Avoid upland areas (aspen slopes and hummocks)
- During calving, the animals completely disperse and you see single females with calves
- Rut in small groups – this season represents the largest groups
- Winter groups
    - Approximately 3-8 animals per group on average
    - Disperse over really large areas
- There are 3 big wetland complexes that are key areas for winter range and all year round
    - These complexes are miles in diameter
    - individuals will move between complexes
    - individuals will remain in one complex and never leave also
    - animals are very spread out in complexes
    - never really congregate except in rut season

Moose in Fort Nelson area:

- Spend summers and fall in the aspen upland areas
- In winter move done into the wetland complexes and winter with caribou

Graham Caribou:

- Typical northern ecotype behaviour and wintering strategy
- Have east/west migrational movements in response to season
    - Move to the front range of the Rockies – to the rain shadow
        - Areas like Hackney Hills, Butler and Adlar Ridge
    - Move east in response to snow
    - the further west you go, get less caribou because of more snow
- winter 2002/2003
    - caribou did not move as far east because very little snow in the area until very late in the year
- winter habitats used are very variable
    - caribou stayed in the timber a lot this year
    - didn't come up to alpine, not as many as last year
    - stayed in pine, spruce/fir and subalpine forests
    - variability depends on snow depths and conditions
        - probably prefer the forage in low elevation forests, but move once snow conditions become restrictive

Moose in Graham:

- are wintering in much higher elevations this year than in previous years
- primarily because slopes were bare until very late in the winter
    - snow patches weren't even available
- moose were observed at tree line
    - they are usually forced down to forested lower elevation because of the snow
- wolves were observed consistently moving between and switching between high and low elevation because there was very little snow restrictions

    - with lots of snow they don't have this mobility
- Williston lake
    - Because a lot of the historical riparian flats are now under water, moose are wintering further up in elevation

Management Concerns:

- 1400 m ATV closure in the Graham River does not include snowmobile use
- ridges in the Graham show lots of snowmobile activity and tracks in the caribou winter range
- possibly pose problems for the caribou who are traveling great distances specifically to these ridges and winter range areas

Elk:

- good winter range on the north slope of Williston Lake
- were transplanted to the north shore
- they compete for forage with sheep as both are grazers
- will feed anywhere and don't have security requirements like the sheep do
- therefore, are pushing sheep into limited forage/security areas
- extensive prescribed burning program for elk
    - benefits sheep too, but may actually be more detrimental to sheep because of the competition with elk
    - should burn specifically for sheep, in areas with sufficient security habitat

Sheep:

- good sheep winter range on the north slope of Williston Lake
- there was a decline in sheep number's during last spring
    - lost a good proportion of sheep to starvation
- Butler Ridge to Nabesche is good winter range
- The sheep in this area are unique because they winter at low elevations
    - Winter along the lake shore
    - These sheep, however, are the only population that have a tick problem
        - Possibly because they are in contact with moose and elk where they are picking the ticks up from
- Will winter in alpine or in shrub/grass bedrock bluffs
- Travel through forests, but no real sedentary winter use of the forested habitats
- Grassy knobs along the lake shore provide good winter habitat if they are in close proximity to cliffs or steep bluffs
    - Importance of grasslands in close proximity to escape terrain characterizes good sheep winter range
    - These hillsides have low snow accumulation

1.7 Mari Wood – March 2003

Elk:

- Random block surveys have been completed for elk (report)
- High elk winter range on north shore
    - Starting from the WAC dam and running along the Peace Arm to the Nabesche River is all really good elk winter range
- Some along the south shore of the Peace Arm

    - But more forested
    - Clearcuts in the area have probably provided secondary witner range areas, and elk have overflowed into the area
    - The south shore has not been identified as critical winter range, but some elk do winter there
- At approximately 1000 m and lower is designated as elk winter range along the Peace Arm
- In 2000, did a survey of elk on the north shore
    - Winter along the lakeshore
    - There is excellent agricultural land that provides good winter habitat in the areas
    - Aspen slopes and hillsides are also used
        - West of Dunlevy Creek
        - As get further west, get less elk because of more snow
        - Bulls are usually on the periphery of the winter range

Moose:

- Aylard Creek and Adams Creek are used by moose during winter
- There is not a lot of good winter range west of Dunlevy for Moose
    - Very few moose in the area, but that is probably due to poor browsing habitat
- Butler Ridge is good winter range
- Along the shoreline on northside
    - Open, south-facing grassland habitats
    - This is perfect for grazers (elk), but not for moose
    - It is not good browsing range
    - Lower value moose habitat

Goats:

- There is a population of goats in the Nabesche area
    - Winter range was outlined by Omineca people and Rod should have this
- Mt. Brewster supports a population of 60-100 goats
- However, no radio-telemetry has been done in the winter, so reports are based on anecdotal information

Deer:

- More significant towards Dunlevy and Hudson's Hope
- Theory that elk have out competed them with the introduction of elk to the north shore
    - Originally 135 were transplanted to the area, and now there is approximately 700
    - But deer are primarily browsers, and elk are grazers so how much overlap is there?

Sheep:

- There are three different wintering strategies observed in sheep in the Peace Arm area
    - High elevation alpine
        - Ex: Butler Ridge, Aylard Ridge and Upper Schooler Creek
    - Low elevation
        - Along reservoir, using cliffs or rock bluffs in the elevation of 600-900 m
        - Steep escape terrain adjacent to grasslands from Schooler Creek to Dunlevy
        - Ex: 20 mile point, rainbow rocks
    - Mid-elevation ranges

        - Branham cliffs (east Branham and west Branham)
            - Both are west of Adams Creek
            - In the elevational range of 1000-1300 m
            - Cliffs adjacent to forest cover or grasslands
            - West side of Aylard Ridge on south end
- **Rod should have telemetry data over 4 years
- sheep range largely depends on snow depth and conditions
- summer range is in high elevation
    - move down in fall
    - this year, some sheep stayed up in high elevation because no snow, so not forced down to lower elevations
    - Ex: Aylard
- Winter range is CRITICAL limiting factor for sheep
    - In 2002 loss 6/18 sheep
    - 5 of these sheep died of starvation, showing low percentage of bone marrow fat
    - during the spring of 2002, there were a lot of late snow storms and snow falling
        - all sheep that were higher in elevation showed starvation, but the sheep in lower elevation areas did not
            - this shows the importance of lower elevation for sheep in the long term – more forage available

1.8 John Elliot – March 2003

Mule Deer:
- Peace, Moberly, Beatton and Cache Creek south facing river banks
- Any south facing slopes
- Used of cover
    - Mixedwood is preferred because it provides a balance between food and snow interception
    - Snow interception maximized in conifer forests
    - Hardwood forests provide the most ample food source
- Areas that are being heavily grazed are critical to ungulate winter range habitat that supports deer
- South facing grassy slopes and shrub communities get trampled down by cows are the quality of the range is destroyed
- Require cover to some degree, but not as critical as for white-tails

White-tailed Deer:
- cover requirements are critical
- much more extensively used by white-tailed deer than by mule deer
- cover must be in close proximity of winter ranges
- forage is primarily within cover?????

Elk:
- Harder to manage for because of the growing problem of elk and farmers fields
- In general they require grassy, south facing slopes

Bison:

- large animals so don't require thermal or security habitat
- would prefer flat terrain, but will use slopes that are gentle and have sufficient forage and some lower snow depths
- steeper slopes may have less snow, but the steepness is not preferred by bison
- not only the quality of forage, but the abundance of forage
    - they are large animals, and require a large biomass of suitable forage
- Upper Liard:
    - Not much knowledge on how these animals use the habitats
- Lower Liard and around Fort Nelson
    - Reports that bison will winter on the cutblocks in the area (anecdotal from local observations)
    - But still very little knowledge on how these separate populations use the habitats
- The differences between the Liard and the Sikanni bison herds is probably based on the topography and habitat available at the two sites
- The Sikanni has different habitat, so the bison use the habitats differently

Moose:

- within the Peace Lowlands, not a great need to manage for the moose
- there is an abundant supply of suitable habitat based on agriculture and varying land uses that support valuable forage for moose
    - will winter in whichever area provides the best forage, and are not as limited by snow
    - too far from the mountains, so they remain in the same areas throughout summer and winter
- moose in the mountains are slightly different
    - closer to the mountains, so they summer in higher elevations, and depending on the snow year, will remain in higher elevations, or move out of the mountains
- moose are not as selective as deer are
    - need to eat large amounts of forage to sustain themselves
    - whereas deer are able to be more selective for what they eat (are able to be more selective because of their smaller size)
    - moose are not as picky, and therefore are not as influenced by snow
        - they need to be around abundant forage
- river valleys were first thought to be of importance because of the abundance of the preferred red-osier dogwood in river bottoms

Sheep:

- have a hard time during the winter because of a number of requirements and external factors affecting their survival
    - require escape terrain to avoid predators
    - require open grassy, south facing slopes for forage
        - however, there are not a lot of habitats within close proximity that support both escape terrain and sufficient forage
        - if leave escape terrain, they are killed by predators

    - if don't leave, they will starve to death
- forage is primarily sedges and grasses
- not a lot of sheep in the Kechika area, does not support a large population
- sheep in the Peace Arm (north side) are unique in that they are the only sheep that winter in low elevation forests
- sheep in the northern mountains winter in the windswept alpine where forage and escape terrain are available

Goats:
- are not as selective in forage as sheep are
- they can eat almost anything and starvation is not a much of a key for goats
- use subalpine forests for forage
- tree wells are utilized for access to forage
- have yet to test if goats are selective for subalpine forage, or whether that is all that is available in high elevation habitats for forest
- cliffs in close proximity to subalpine forage are good wintering habitats
- will forage on anything that is available

Caribou:
- very little is known about caribou
- it appears that the caribou in the northern mountains have slightly different needs, requirements and behaviours than other northern ecotype caribou
    - northern mountain caribou are acting more like a cross between the boreal and northern ecotypes
- very hard to manage for this species, because we don't know what they do

Overall Management Direction:
- if had the power to draw protected areas on a map for ungulate winter range, need to identify areas that are threatened or have the potential to be threatened by forestry, oil and gas to some extent, and grazing activities
- mule deer – some forest cover that may be of value to the forest industry that should be protectected
    - grazing should be eliminated in areas of winter range
- moose – cannot do much to protect moose habitat, as long as abundant forage is available
- goats and sheep – are in areas that do not have high timber values or forest activity (no conflict)
    - much of the important areas are already in parks (Tuchodi, Graham)
- elk – conflicts between farmers who don't want the elk around and managing for them
- bison – do not use forest cover
- therefore, it appears that we should try and manage for caribou, encompassing the other requirements and setting up specific areas