AN ASSESSMENT OF GRAZING CAPACITY IN THE FRANCES CREEK RANGE UNIT

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ABSTRACT

A range survey was conducted in the Frances Creek Range Unit near Radium, British Columbia. Fifty transects were established, of which 25 had production cages. Based on field surveys conducted in early July, 1996, five broad range types were delineated including cutblocks, wetlands, open forest, mature forest, and grasslands. Within these range types, eight vegetation community types were classified and mapped within the range unit. Productivity estimates indicated that the capacity for livestock with current grazing patterns are: 756 AUMs for Hidden Valley Pasture, 1164 AUMs for Franz Pasture, 725 AUMs for Brady Pasture, 257 AUMs for Elliot Pasture, and 413 AUMs for Height-of-Land Pasture.

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1.0 INTRODUCTION

Rangelands are an important resource in British Columbia, particularly for the ranching industry. In 1989/1990, almost one million animal unit months (AUMs) or 60% of the total forage requirement for beef production in the province were produced on Crown lands (Meidinger and Pojar 1991). Aside from providing grazeable forage for domestic livestock, rangeland use may impact fish habitat and provide important habitat for wildlife, and various recreational opportunities and aesthetic benefits for residents and visitors. Although rangelands include natural grasslands, shrublands, alpine communities, and wet meadows, forested lands contribute significantly to the forage base, accounting for almost 80% of the rangelands in British Columbia (Meidinger and Pojar 1991). Logging activities and fire are important factors in the conversion of forest into rangelands.

Management of rangelands is primarily under the jurisdiction of the Forest Service, British Columbia Ministry of Forests. Because of the importance of rangeland users (people or animals or both) the Ministries of Environment and Agriculture and Fisheries may also become involved in rangeland management and planning (MOF 1989). Within the Ministry of Forests, technical expertise in managing Crown rangelands is provided by the Range Section which issues grazing tenures and hay cutting permits for domestic livestock, monitors tenure and permit compliance, and conducts vegetation inventories.

Rangeland management and planning activities of the Range Section are based on the guidelines and policies outlined in the Range Program. The program, which was recently reviewed by the Range Program Review Task Force (MOF 1989), is administered through six regions and 43 districts located throughout British Columbia. The Frances Creek area has historically been used for timber harvesting and domestic livestock grazing, but as in other areas of the province, a more comprehensive plan for resource allocation was required.

As part of its on-going range management program in the Invermere Forest District, the Range Section identified a need to conduct a forage assessment of the Frances Creek Range Unit. The following report, which was prepared by Westworth, Brusnyk & Associates Ltd., presents the results of this forage assessment. The information should assist resource managers in developing and implementing management plans that will ensure sustained forage yields for domestic livestock and also ensure compatibility with other land uses in the region.

1.1 Objectives

The overall objective of the study was to determine forage production levels, species composition of plant communities, and carrying capacity for the Frances Creek Range Unit. Specific objectives of the range inventory were to:

- Identify and map primary and secondary ranges;
- Identify and sample major vegetation communities within primary and secondary ranges; and
- Collect forage productivity data to determine carrying capacity within each vegetation community.

1.2 Regional and Biophysical Setting

The Frances Creek Range Unit is located in the Rocky Mountain Trench west of Radium Hot Springs. It is bounded on the east by Steamboat Mountain, on the south by Forster Creek, on the north by Hurst Creek and Frances Creek, and on the west by the lower slopes of the Purcell Mountains (Figure 1). Frances Creek, which originates in the Purcell Mountains west of the study area, flows south through the center of the range and empties into the Columbia River. The range unit is composed of five main pastures; these include Hidden Valley, Brady, Franz, Elliot and Height-of-Land. This report describes the range inventory for all five pastures. Arvid Pasture, which was used only for a few days during cattle turnout has been included with Brady Pasture for the purposes of this report. Each of the main pastures, which range in size from 1882 ha to 6877 ha, contains different proportions of crown and private lands. (Table 1). Frances Creek Range Unit can be accessed by road from Highway 93/95. A gravel road, known as the Westside Road provides access to all five pastures. Major land uses in the area consist of livestock grazing, timber harvesting, and recreation.

The Frances Creek Range Unit is both geographically and ecologically moderately diverse. Three biogeoclimatic zones are represented in the range unit including the Engelmann Spruce-Subalpine Fir, Montane Spruce and Interior Douglas-fir (Meidinger and Pojar 1991). However, Crown grazing lands, the focal point of this study, are primarily located in the Interior Douglas-fir zone. Although species composition of these biogeoclimatic zones is relatively well known, population sizes and in the case of wildlife, patterns of habitat use and seasonal movements have not been well documented.

Based on discussions with local individuals and Ministry of Forests personnel, the lower elevations of Frances Creek Range Unit appear to be used moderately by wintering elk herds. During the summer, elk move to higher elevations. White-tailed deer and mule deer are also common at lower elevations while moose prefer riparian and cutblock habitats adjacent to forest cover.

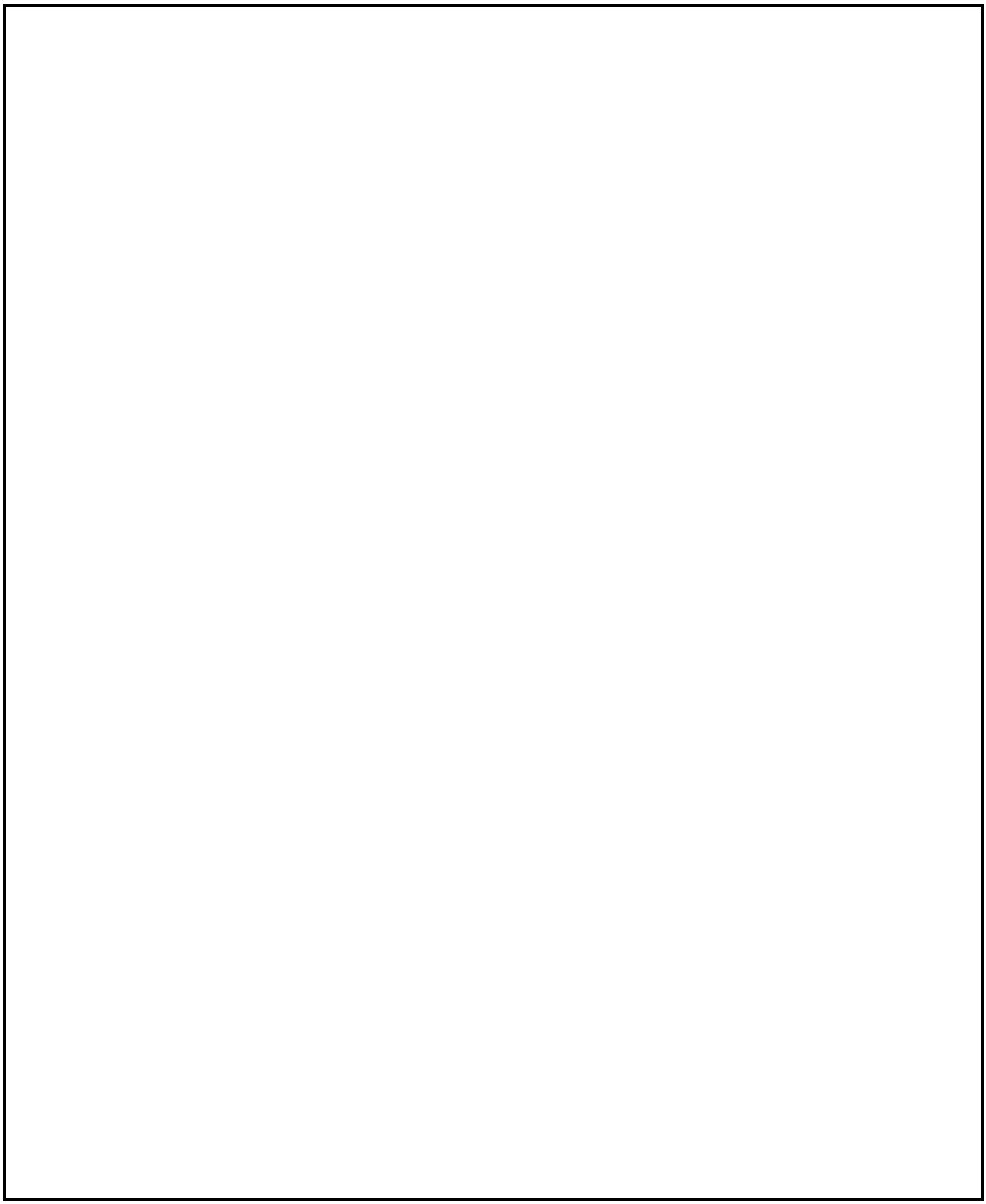

Figure 1. Location of the Frances Creek Range Unit.

Table 1. Area of private and Crown lands in the Frances Creek Range Unit.

Pasture	Total Area (ha)	Private Lands (ha)	Crown Lands	
			Utilized	Unutilized (ha)
Hidden Valley	5567	340	1235	3992
Franz	6877	300	1823	4754
Brady	3087	0	1051	2036
Elliot	2593	0	420	2173
Height-of-Land	1882	631	707	544

1.3 Pastures of the Frances Creek Range Unit

Hidden Valley Pasture is located at the north end of Frances Creek Range Unit. Valley bottom lands are a mixture of coniferous forests and cutblocks. Lodgepole pine, Douglas-fir, and spruce are the dominant tree species. Young forests are dominated by lodgepole pine, whereas older or mature forests contain mixtures of two or more coniferous species. Aspen is found sporadically mixed with other conifers but seldom occurs in pure stands. Although topographically diverse, most of the range land within this pasture lie at elevations between 1100 and 1200 m along the lowlands adjacent to Frances Creek. Cutblocks, which are often extensive, are one of the most distinctive feature of this pasture. Most of the utilized range is restricted to cutblocks, particularly more recent cutblocks that have abundant forage and low tree cover. Open forest areas are also grazed but these are relatively uncommon in Hidden Valley Pasture. Numerous small water bodies and creeks scattered throughout this pasture provide livestock and wildlife with good sources of water. Three small lakes, Lower and Upper Halgrave Lakes and Steamboat Lake, are located on the east side of Frances Creek along the west flank of Steamboat Mountain.

Franz Pasture extends south from Hidden Valley Pasture along the east slopes of the lower Purcell Mountain range to Forster Creek. Frances Creek forms the eastern boundary of Franz Pasture. The west side of Franz Pasture is dominated by closed coniferous forests on steep slopes at elevations of 1200 to over 2100 m but most of the accessible range land within this pasture is located between 1050 and 1200 m on rolling topography. The majority of this range land consists of former forested areas that have been clearcut or partially cut. Natural open woodlands are uncommon in this pasture. Mature forest areas that have not been logged are dominated by mixed coniferous forests of lodgepole pine and Douglas-fir, and

to a lesser extent white or Engelmann spruce. Trembling aspen is relatively uncommon in Franz Pasture but where it is present in mature stands it is codominant with lodgepole pine, Douglas-fir or spruce.
Frances Creek and numerous small creeks and small water bodies distributed throughout the pasture provide good sources of water, which are readily accessable to both livestock and wildlife. In general, the small water bodies are shallow and are surrounded by zones of semi-emergent vegetation dominated by bulrushes and sedges. A narrow strip of riparian vegetation occurs along some sections of Frances Creek. However, most vegetation along Frances Creek consists of non-riparian species and is similar to vegetation present on the surrounding uplands.

Brady Pasture extends south from Hidden Valley Pasture and is bordered on the east by Steamboat Mountain and on the west by Frances Creek. Like Hidden Valley and Franz Pastures, most of the current rangeland consists of formerly forested areas that have been clearcut. Most forest harvesting has occurred between elevations of 1000 and 1200 m on rolling topography or gentle slopes. Little or no logging has occurred on the steep west-facing slopes of Steamboat Mountain between 1200 and 1500 m. These slopes are largely dominated by mature coniferous forests of lodgepole pine and Douglas-fir. However, some small open forest areas dominated by forbs and shrubs do occur on steep west-facing slopes. These open areas probably provide good winter habitat for wildlife because snow accumulations are usually lower and snow melt usually occurs earlier than in surrounding forested areas. Frances Creek, along with numerous other small creeks and water bodies distributed throughout Brady pasture provide good sources of water, which are readily accessable, for both livestock and wildlife.

Elliot Pasture is located east of Brady and Franz Pastures, and south of Steamboat Mountain. It is bounded by Frances Creek in the west and by the Columbia River in the east. Elliot Pasture, which extends from elevations of 1000 m near Frances Creek and 800 m near the Columbia River to over 1500 m at the top of Steamboat Mountain, is topographically diverse. Most of the existing rangeland consists of previously forested areas that have been clearcut or partially cut, including areas that are presently used to grow Christmas trees. The amount of range land currently available in Elliot Pasture is lower than that of neighbouring pastures. Recent logging activities have been much less extensive than in Brady or Franz Pastures. Many of the older harvested areas are now thickly forested and have little forage or grazing potential. Lack of good water sources in some areas of this pasture also limits potential for livestock grazing. Open forest areas dominated by grasses, forbs and shrubs are found along the west slope of the Columbia River Valley. These open areas are probably important winter wildlife habitat, particularly for elk and white-tailed deer.

Height-of-Land Pasture is located south of Elliot Pasture in the southeast corner of the range unit. Forster Creek, which flows east along the southern margin of Height-of-Land Pasture, is the boundary between Frances Creek and Forster-Horsethief Range Units. Height-of-Land Pasture, which varies in elevation from approximately 800 m near the Columbia River to just over 1000 m, is much less topographically diverse than the other pastures in the range unit. Open forest areas and grasslands are more prevalent in this pasture than in any other pasture in the range unit. Douglas-fir and lodgepole pine forests in this pasture have been extensively logged and grassland/open forest areas are found on steep slopes with southerly aspects and along ridge tops. Most of the range land consists of these open forest areas as well as extensive areas that have been partially or entirely logged. This pasture is very important as winter wildlife habitat especially for elk and white-tailed deer.

2.0 METHODS

2.1 Preliminary Investigations

Prior to the field survey, preliminary range types were mapped using 1:20,000 black-and-white aerial photographs and 1:20,000 forest cover maps. A reconnaissance-level field trip of the range unit was undertaken with the Range Ecologist to obtain an overview of community types and grazing practices. Sampling effort for the vegetation and range survey was then stratified on the basis of the preliminary range type map and information obtained during the field trip. This sampling approach resulted in the establishment of 50 transects within the 5 pastures of the Frances Creek Range Unit. Transect locations were marked on aerial photographs to facilitate classification and delineation of community types.

2.2 Vegetation Survey

A vegetation survey designed to document species composition and percentage cover was conducted July 2 - 20, 1996 using sampling methods described in Alberta Forest Service's Range Survey Manual (Alberta Forest Service 1990). Vegetation was surveyed along 50 transects, 25 of which had production cages. Vegetation was sampled on 15 microplots placed at 2 m intervals along each 30 m transect. Cover (%) of grass and forb species was estimated using 20 cm x 50 cm quadrats and, when present, shrub species cover was estimated on 1 m x 1 m quadrats. A 20 m x 20 m plot was used to determine cover estimates for trees and tall shrubs (stems 2.5 m). When the cover for a species observed within the microplots exceeded 15% estimates were recorded to the nearest 5%, whereas cover estimates for species with cover values between 0 and 15% were estimated to the nearest 1%. Cover estimates for trees and tall shrubs in the macroplot were recorded to the nearest 5%. All information was recorded on specifically-designed grazing inventory forms provided by the B.C. Ministry of Forests. A 35 mm colour photograph was also taken along each transect to document existing vegetation conditions. To assist in future range monitoring programs, all transect locations (UTM coordinates) were determined using a hand held Global Positioning System unit. A permanent marker, consisting of a metal stake with attached metal tag, was placed at the beginning of each transect to further assist future transect relocation.

2.3 Forage Production

One objective of the study was to collect forage production data for use in calculating carrying capacities for the Frances Creek Range Unit. Herbage production and forage use levels within a range type are typically determined by harvesting vegetation from protected (e.g. production cages) and unprotected

quadrats at each transect. In the present study, exclosure cages constructed from 2.54 cm^2 wire mesh were used to exclude herbivore grazing from an area of approximately 1.25 m^2.

The assessment of forage production in the Frances Creek Range Unit was undertaken between August 7-10, 1996. Vegetation was hand harvested from 2, 50 cm x 100 cm, quadrats at transects which contained exclosure cages (one from beneath the exclosure cage and one outside) if there was obvious grazing activity outside the cage. If there was no obvious grazing outside the cage, only the quadrat in the exclosure cage was harvested. In the case of transects where there were no exclosure cages, only 1 quadrat was harvested. In this case, vegetation was hand harvested from a 50 cm x 100 cm quadrat randomly placed near the beginning or end of each transect. Harvested material was field sorted into grasses (and grass-like vegetation), forbs, and shrubs and placed into labelled paper bags for drying.

2.4 Laboratory Methods and Data Analysis

Upon the completion of the field work, the harvested vegetation was oven-dried for 48 hours at 70°C and weighed to the nearest 0.1 gm. Production (kg/ha) was calculated from raw data ($g/0.5m^2$) by multiplying by 20 (a conversion factor for converting $g/0.5m^2$ to kg/ha). Herbage production on each range type was calculated as the average of all clipped plots within each range type. For domestic livestock, forage was defined as that portion of the herbage that is palatable to the grazing animal in question. Since livestock are primarily grazers, the forb portion, with the exception of black medic, alfalfa, sweet clover and white clover, of all range types was considered unpalatable and was not considered to be forage. In the case of wildlife, all forbs and grasses and some shrubs were considered as palatable forage.

Species composition and foliar cover estimates for each quadrat were input into digital files for analysis. Data entry accuracy was verified using the Data Entry II module of SPSS for Windows statistical software. Following data entry, average species cover values were calculated for each transect. Transect data was then classified using TWINSPAN (Two-way Indicator Species Analysis), a computer program that produces an ordered two-way table in which similar transects are grouped together. The groups established by TWINSPAN were then inspected to determine the appropriate level for division into preliminary community types. Final classification of transects into community types was based on TWINSPAN divisions and modifications based on variations in dominant plant species.

Data collected from 70 transects in 2 adjoining range units (Frances Creek and Forster-Horsethief Creek) were jointly analyzed with TWINSPAN. Data from both range units were combined to provide an enhanced data set on which to base community type descriptions. Some community types derived from

the classification process occur in both range units while other community types are restricted to one range unit. The distribution of community types within each range unit is summarized in Table 2. A separate report describes the vegetation community types present in Forster-Horsethief Range Unit.

Table 2. Vegetation community types found in Frances Creek and Forster-Horsethief Range Units.

	Range Unit	
Community Type	**Frances Creek**	**Forster-Horsethief Creek**
1. Kentucky bluegrass/black medic-white clover	✓	✓
2. Junegrass/black medic-rosy pussytoes	✓	
Douglas-fir/junegrass/rosy pussytoes		✓
3. Douglas-fir-lodgepole pine/kinnikinnick/pinegrass	✓	✓
4. Trembling aspen/kinnikinnick/pinegrass	✓	
Trembling aspen/saskatoon/pinegrass		✓
5. Lodgepole pine/dwarf blueberry/pinegrass	✓	
Lodgepole pine/snowberry/pinegrass		✓
6. Sedge fen	✓	✓
7. Scrub birch-Labrador tea-shrubby cinquefoil	✓	
Cow parsnip-fireweed		✓
8. Bunchberry/black huckleberry/Engelmann spruce	✓	

2.5 Calculating Carrying Capacity

Stratification of the study area into primary, secondary, and non-use (tertiary) ranges is the first step in calculating carrying capacity. Primary range can be defined as those areas that livestock prefer to use under very little management (Maduram 1979). Secondary range is characterized as having some feature(s) that restrict livestock grazing and may include steep slopes, barriers to grazing such as brush, long distances to water, or a plant community that does not contain palatable forage species. Carrying capacity does not usually include forage growing on secondary range since this may result in overstocking the primary range. Non-use areas or tertiary range were those areas that contain significant barriers to movement such as excessive amounts of deadfall, steep slopes, and/ or absence of palatable forage.

Primary and secondary range were further subdivided into vegetation community types. Vegetation community types were considered to be areas exhibiting uniform species composition and herbage production levels. Productivity was then estimated for each community type, and a weighted mean (weighted by area) of herbage production in primary and secondary range was calculated. Unpalatable herbage was subtracted from total herbage to provide forage estimates for domestic livestock. A safe use factor was also applied to the available forage and was defined as the level of herbivore grazing that the vegetation can withstand indefinitely without lasting detrimental effects. Typical safe use factors used in inventories of native rangelands include a 50% level of use during the growing season and a 70% level of use during the dormant season. Tame grass reseedings can generally withstand a higher level of use of growing season herbivore use (60%) than native grass swards. Therefore, herbage growing on primary range minus unpalatable herbage minus a safe use factor yields available forage for domestic livestock consumption. Since 1 AUM is equal to 450 kg of forage (Basarab 1987), grazing capacity (in AUMs) can be calculated.

Calcualations of forage production on open forest areas are adjusted to account for partial canopy closure and thus, result in lower overall forage production estimates. Canopy closure was obtained either from 1:20,000 forest cover maps or estimated from 1:20,000 black-and-white airphotos for each polygon on the range map, i.e. if polygon 1 covers 400 ha and has 30% crown closure the effective production area is 70% x 400 = 280 ha. A total effective production area is obtained for all polygons for each community type within primary and secondary range. For example, if community type 1 in primary range has an estimated production of 500 kg/ha and an effective production area of 300 ha the number of AUMs in CT1 on primary range would be: 300 ha x 500 kg/ha = 150,000 kg of production.

Therefore:

$$\text{AUMs} = \frac{\text{150000 kg of production}}{\text{450 kg/day}} = \text{333 days of grazing for 1 cow.}$$

3.0 RESULTS AND DISCUSSION

3.1 Community Type Descriptions

Eight vegetation community types characterized by 170 vascular plant species (Appendix 1) were identified in the Frances Creek Range Unit. To provide summary descriptions of each community type identified in the range unit, a checksheet format was used. Each checksheet contains information on site location, important biophysical features, and plant species cover data. The grazing capacity of each community type along with a representative photograph of each transect also accompanies each checksheet.

Community Type 1 (N = 7). Kentucky bluegrass/black medic-white clover (Photo 1).

This community type is typical of meadows, landings, and roadsides that have been seeded. Typically, mineral soil is exposed and early successional mosses (e.g. *Ceratodon* spp.) are often prominent.

Representative Sites: FC4, FC13, FC17, FC18, FC29, FC38, FC45
Landscape Position: Upland (P)
Elevation: 780-1300 m
Slope: 0-6 %
Aspect: Variable

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	**Range**
Grasses			
Poa pratensis	Kentucky bluegrass	4	(0-10.1)
Dactylis glomerata	orchardgrass	3	(0-7.2)
Elymus trachycaulus	slender wheatgrass	1	(0-5.8)
Elymus repens	quackgrass	1	(0-2.8)
Phleum pratense	timothy	1	(0-4)
Bromus inermis	smooth brome	1	(0-4.3)
Forbs			
Medicago lupulina	black medic	5	(0-24.2)
Trifolium repens	white clover	3	(0-6.5)
Taraxacum officinale	common dandelion	2	(0.1-9.4)
Medicago sativa	alfalfa	1	(0-5.3)
Melilotus officinalis	yellow sweet-clover	1	(0-4.1)
Astragalus miser	timber milk-vetch	1	(0-4)
Shrubs			
Symphoricarpos occidentalis	western snowberry	t[1]	(0-1.9)
Symphoricarpos albus	common snowberry	t	(0-0.1)
Rosa acicularis	prickly rose	t	(0-0.2)
Spiraea betulifolia	birch-leaved spiraea	t	(0-0.1)

Mosses/Lichens

Ceratodon spp.	5	(0-11.1)

Production (kg/ha):	Grasses	1511
	Forbs	942
	Shrubs	19
	Total	**2472**

Stocking Rate: 2264 kg/ha[2] ÷ 450 kg/ha x 50% stocking rate = **2.5 AUMs per hectare**

1 t = less than 0.5%

2 Includes 80% of forb cover that is estimated to be palatable to livestock.

Community Type 2 (N = 9). Junegrass/black medic-rosy pussytoes (Photo 2).

This community type is found primarily in the southern portion of Frances Creek Range Unit in Height-of-Land Pasture and along the east-facing flank of the Columbia River valley in Elliot Pasture. Community Type 2 (CT2) is an open-treed grassland community dominated by an understory of grass and forb species that are more typically associated with grassland ecosystems. Site conditions are generally drier than the surrounding open or closed forest communities. Characteristically CT2 is found on steep slopes or ridge crests that have south to southwest exposures. CT2 is also preferred range for elk during the winter because of its aspect and plant species composition. FC39 has significant cover of *Stipa comata* (needle-and-thread grass) which was absent from other transects in this CT. Whether this justifies re-classification of FC39 as a separate CT will require additional sampling and analysis.

Representative Sites: FC2, FC3, FC22, FC23, FC24, FC31, FC39, FC40, FC42
Landscape Position: Upland (P)
Elevation: 780-1200 m
Slope: 0-53 %
Aspect: 52-244 (Predominantly south to southwest)

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	**Range**
Grasses			
Koeleria macrantha	junegrass	1	(0.3-2.7)
Poa pratensis	Kentucky bluegrass	1	(0-3.8)
Stipa nelsonii	Columbia needlegrass	1	(0-3.5)
Forbs			
Medicago lupulina	black medic	7	(0-33.7)
Antennaria microphylla	rosy pussytoes	3	(0-6.7)
Balsamorhiza sagittata	arrow-leaved balsamroot	1	(0-10.3)
Lithospermum ruderale	lemonweed	t	(0-0.4)
Oxytropis sericeus	silky locoweed	t	(0-0.5)
Shrubs			
Arctostaphylos uva-ursi	kinnikinnick	2	(0-8.7)
Amelanchier alnifolia	saskatoon	1	(0-3.2)

Mahonia repens	creeping Oregon-grape	1	(0-3.8)
Trees			
Pseudotsuga menziesii	Douglas-fir	5	(0-14)
Populus tremuloides	trembling aspen	1	(0-3.7)
Mosses/Lichens			
Cladina spp.		4	(0-16.1)
Ceratodon spp.		1	(0-2.8)

Production (kg/ha):	Grasses	447
	Forbs	220
	Shrubs	186
	Total	**853**

Stocking Rate: 601 kg/ha[1] ÷ 450 kg/ha x 50% stocking rate = **0.7 AUMs per hectare**

1 Includes 70% of forb cover that is estimated to be palatable to livestock.

Community Type 3 (N = 7). Douglas-fir-lodgepole pine/kinnikinnick/pinegrass (Photo 3).

This community type is characteristic of open to closed forest areas that have moderate site moisture. Both Douglas-fir and lodgepole pine may be present and their cover may vary from low to moderate. CT3 is similar to CT4 and CT5 in terms of species composition and productivity. It differs from CT4 by the absence or very low cover of trembling aspen and overall lower shrub cover. Saskatoon, if present, has very low cover. The moss layer in CT3 is generally well developed with *Pleurozium* spp. as the dominant moss. Moss cover in CT4 is generally poorly developed with *Bracythecium* spp. as the most characteristic moss. CT3 is distinquished from CT5 by low cover of dwarf blueberry, fireweed, and *Ceratodon* spp., and by higher cover of Douglas-fir and *Pleurozium* spp. In general CT3 is either more successionally mature and/or less disturbed than CT5.

Representative Sites: FC1, FC26, FC27, FC33, FC41, FC44, FC49
Landscape Position: Upland (P)
Elevation: 940-1300 m
Slope: 0-27 %
Aspect: Variable, 54-270

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	Range
Grasses			
Calamagrostis rubescens	pinegrass	3	(1.1-7.3)
Forbs			
Linnaea borealis	twinflower	2	(0-7)
Fragaria virginiana	strawberry	2	(0-3.9)
Aster conspicuus	showy aster	1	(0-3.1)
Taraxacum officinale	common dandelion	1	(0-1.3)
Arnica cordifolia	heart-leaved arnica	1	(0-2.4)
Shrubs			
Arctostaphylos uva-ursi	kinnikinnick	3	(0-10.6)
Symphoricarpos albus	common snowberry	2	(0-8.8)
Shepherdia canadensis	soopoolallie	1	(0-8.3)
Spiraea betulifolia	birch-leaved spiraea	1	(0-2.5)

Vaccinium caespitosum	dwarf blueberry	1	(0-3.5)
Mahonia repens	creeping Oregon-grape	1	(0-1.7)
Rosa acicularis	prickly rose	1	(0.1-1.5)
Trees			
Pseudotsuga menziesii	Douglas-fir	18	(2.3-28)
Pinus contorta	lodgepole pine	9	(0-28)
Mosses/Lichens			
Pleurozium spp.		12	(0-51.3)
Peltigera spp.		2	(0-3.7)
Cladonia spp.		1	(0.1-2)

Production (kg/ha):	Grasses	477
	Forbs	148
	Shrubs	78
	Total	**703**

Stocking Rate: 477 kg/ha ÷ 450 kg/ha x 50% stocking rate = **0.5 AUMs per hectare**

Community Type 4 (N =3). Trembling aspen/kinnikinnick/pinegrass (Photo 4).

This community type is characteristic of open to closed forest on moist sites with trembling aspen dominant or codominant in the tree layer. The understory is shrub-dominated with kinnikinnick and common snowberry as the most prominent species. The leaf-litter layer is generally well developed and moss cover is low. Although this community type occurs only sporadically in the Frances Creek Range Unit, it probably provides significant wildlife habitat because of the relatively high cover of preferred browse species such as saskatoon and aspen. Browse production and availability is generally higher in young aspen stands. If these young stands have nearby cover that is suitable for wildlife, their potential as a source of browse and forage may be high.

Although prickly rose occurs consistently across all transects of this CT it is probably too ubiquitous to usefully differentiate community types. Kinnikinnick was selected as the characteristic shrub species because in general it appears to indicate somewhat drier site moisture conditions. Further work on a wider cross section of aspen dominated sites in the Invermere Forest District is required to confirm kinnikinnick's indicator potential.

Representative Sites: FC25, FC43, FC48
Landscape Position: Upland (P)
Elevation: 980-1180 m
Slope: 0-9 %
Aspect: Variable, 0-238

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	Range
Grasses			
Calamagrostis rubescens	pinegrass	2	(0.5-2.9)
Forbs			
Aster ciliolatus	fringed aster	2	(0.3-5.6)
Fragaria virginiana	wild strawberry	2	(1.2-2.0)
Linnaea borealis	twinflower	2	(0-3.7)
Aster conspicuus	showy aster	1	(0-1.7)
Hieracium albiflorum	white-flowered hawkweed	1	(0-1.3)
Medicago lupulina	black medic	1	(0-2.1)

Taraxacum officinale	common dandelion	1	(0.1-1.6)
Trifolium repens	white clover	1	(0-1.9)
Shrubs			
Arctostaphylos uva-ursi	kinnikinnick	5	(0.8-8.9)
Symphoricarpos albus	common snowberry	3	(0.1-4.6)
Rosa acicularis	prickly rose	3	(0.9-4.2)
Amelanchier alnifolia	saskatoon	2	(0.3-3.3)
Shepherdia canadensis	soopolallie	2	(0.3-5.0)
Mahonia repens	creeping Oregon-grape	1	(0.1-2.1)
Trees			
Populus tremuloides	trembling aspen	17	(8.4-28)
Picea glauca	white spruce	4	(0-6.5)
Pinus contorta	lodgepole pine	1	(0.9-1.9)

Production (kg/ha):	Grasses	449
	Forb	220
	Shrubs	178
	Total	**847**

Stocking Rate: 449 kg/ha ÷ 450 kg/ha x 50% stocking rate = **0.5 AUMs per hectare**

Community Type 5 (N = 18). Lodgepole pine/dwarf blueberry/pinegrass (Photo 5).

This community type is characteristic of recent cutblocks on moist sites. Trees are immature and tree cover is variable with various mixtures of lodgepole pine and trembling aspen, and to a lesser extent Douglas-fir. This is an early successional community in which the moss layer is generally absent or poorly developed. *Pleurozium* spp., which is characteristic of mature, undisturbed mixed or conifer dominated communities, generally has low cover. The moss genus *Ceratodon,* which is often characteristic of disturbed sites with exposed mineral soil, is prominent at most sites in CT5. Forb and low shrub layers are usually well developed. Pinegrass cover is also usually moderately well developed. The prominence of fireweed in the forb layer is also typical of communities that are disturbed or in an early stage of succession. Dwarf blueberry is the leading shrub species and often has high cover.

Representative Sites: FC5, FC6, FC7, FC8, FC9, FC10, FC11, FC12, FC14, FC15, FC16, FC19, FC20, FC21, FC30, FC32, FC35, FC37
Landscape Position: Upland (P)
Elevation: 1020-1360 m
Slope: 0-15 %
Aspect: Predominantly open, 0-338°

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	Range
Grasses			
Calamagrostis rubescens	pinegrass	2	(0-4.1)
Poa pratensis	Kentucky bluegrass	1	(0-3.7)
Forbs			
Fragaria virginiana	wild strawberry	5	(0-15.4)
Linnaea borealis	twinflower	2	(0-.5)
Cornus canadensis	bunchberrry	1	(0-9.4)
Arnica cordifolia	heart-leaved arnica	1	(0-3.7)
Aster ciliolatus	fringed aster	1	(0-5.8)
Epilobium angustifolium	fireweed	1	(0-6.6)
Hedysarum sulphurescens	yellow hedysarum	1	(0-2.3)
Taraxacum officinale	common dandelion	1	(0-6.7)
Antennaria neglecta	field pussytoes	1	(0-3.3)

Shrubs

Vaccinium caespitosum	dwarf blueberry	6	(0-18.8)
Arctostaphylos uva-ursi	kinnikinnick	2	(0-8)
Symphoricarpos albus	common snowberry	1	(0-3.4)
Rosa acicularis	prickly rose	1	(0.1-4.3)
Mahonia repens	creeping Oregon-grape	1	(0-5.3)
Shepherdia canadensis	soopolallie	1	(0-2.3)

Trees

Pinus contorta	lodgepole pine	5	(0-14)
Populus tremuloides	trembling aspen	1	(0-5.6)

Mosses/Lichens

Ceratodon spp.		2	(0-11.5)
Cladonia spp.		1	(0-2.8)

Production (kg/ha):	Grasses	505
	Forbs	361
	Shrubs	257
	Total	**1123**

Stocking Rate: 505 kg/ha ÷ 450 kg/ha x 50% stocking rate = **0.6 AUMs per hectare**

Community Type 6 (N = 3). Sedge fen (Photo 6).

This community type is found scattered throughout the range unit in depressional areas often associated with small waterbodies. Although this community type may be used by wildlife, it is also likely used by livestock because of its close proximity to water. The sites examined showed only light use by livestock and wildlife.

Representative Sites: FC34, FC36, FC50
Landscape Position: Bottomland (B)
Elevation: 1080 m
Slope: 0 %
Aspect: Level

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	Range
Grasses			
Carex utriculata	beaked sedge	4	(0-8.5)
Carex aquatilis	water sedge	2	(0.1-4.1)
Carex lanuginosa	woolly sedge	2	(0-4.7)
Shrubs			
Betula glandulosa	scrub birch	2	(0-6.1)
Salix brachycarpa	short-fruited willow	2	(0-3.8)
Salix maccalliana	Maccall's willow	1	(0-4.0)
Salix candida	hoary willow	1	(0-2.1)
Trees			
Picea mariana	black spruce	1	(0-3.7)
Mosses/Lichens			
Drepanocladus spp.		11	(3.3-21.8)
Campylium spp.		8	(0-13.9)
Tomenthypnum spp.		4	(0-11)
Aulacomnium spp.		3	(0-7.5)

Production (kg/ha):	Grasses	1873
	Forbs	35
	Shrubs	104
	Total	**2012**

Stocking Rate: 1873 kg/ha ÷ 450 kg/ha x 50% stocking rate = **2.1 AUMs per hectare**

Community Type 7 (N = 2). Scrub birch -Labrador tea-shrubby cinquefoil (Photo 7).

This community type appears to occur only rarely in the Frances Creek range unit and was found only along Frances Creek in Franz Pasture. CT7 is restricted to a narrow band along Frances Creek where the soil is water saturated for at least part of the year. Livestock use in this CT is moderate to high. Most of this use probably occurs as a result of livestock attempting to gain access to water.

Representative Sites: FC46, FC47
Landscape Position: Bottomland (B)
Elevation: 980 m
Slope: 0-4 %
Aspect: 0-82°

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	Range
Grasses			
Carex interior	inland sedge	1	(0-2.5)
Carex sp.	sedge	1	(0-2.5)
Poa palustris	fowl bluegrass	1	(0-1.5)
Calamagrostis canadensis	bluejoint	1	(0-1.1)
Shrubs			
Betula glandulosa	scrub birch	15	(8.4-18.7)
Ledum groenlandicum	Labrador tea	8	(3.7-11.5)
Potentilla fruticosa	shrubby cinquefoil	6	(4.3-6.5)
Alnus incana	mountain alder	3	(0-5.6)
Amelanchier alnifolia	saskatoon	2	(0-3.5)
Arctostaphylos uva-ursi	kinnikinnick	2	(0-3.7)
Cornus stolonifera	red-osier dogwood	t	(0-0.9)
Forbs			
Aster ciliolatus	fringed aster	4	(2-5.8)
Linnaea borealis	twinflower	4	(2.8-4.2)
Mitella nuda	common mitrewort	2	(0.5-2.3)
Galium boreale	northern bedstraw	1	(0.3-0.7)

Trees

Picea mariana	black spruce	3	(0-5.6)
Pinus contorta	lodgepole pine	2	(0-3.7)

Mosses/Lichens

Pleurozium spp.	7	(3.9-9.6)
Brachythecium spp.	3	(0-4)
Cladonia spp.	1	(0-1.7)

Production (kg/ha):	Grasses	1599
	Forbs	39
	Shrubs	83
	Total	**1721**

Stocking Rate: 1599 kg/ha ÷ 450 kg/ha x 50% stocking rate = **1.8 AUMs per hectare**

Community Type 8 (N = 1). Bunchberry/black huckleberry/Engelmann spruce (Photo 8).

This community type is found on east facing slopes on the west side of Hidden Valley and Franz Pastures. CT8 is a closed canopy conifer forest with moderately well developed shrub and forb layers, and a very well developed feathermoss carpet. Forage and browse production are extremely low in CT8 and it is considered to be unutilized range.

Representative Sites: FC28
Landscape Position: Upland (P)
Elevation: 1280 m
Slope: 5 %
Aspect: 40

Scientific Name	Common Name	Foliar Cover (%)	
		Mean	Range
Forbs			
Cornus canadensis	bunchberry	4	
Linnaea borealis	twinflower	3	
Aralia nudicaulis	wild sarsaparilla	1	
Lycopodium annotinum	stiff clubmoss	1	
Aster conspicuus	showy aster	1	
Pyrola chlorantha	arctic wintergreen	1	
Chimaphila umbellata	prince's pine	1	
Shrubs			
Vaccinium membranaceum	black huckleberry	4	
Acer glabrum	Douglas maple	4	
Viburnum edule	highbush-cranberry	1	
Vaccinium scoparium	grouseberry	1	
Spiraea betulifolia	birch-leaved spiraea	1	
Trees			
Picea engelmannii	Engelmann spruce	25	
Pinus contorta	lodgepole pine	15	
Abies lasiocarpa	subalpine fir	15	

Tsuga heterophylla	western hemlock	2

Mosses/Lichens

Pleurozium spp.	50
Hylocomium spp.	20
Ptilium spp.	3
Peltigera spp.	2

Production (kg/ha):	Grasses	0
	Forbs	24
	Shrubs	1
	Total	**25**

Stocking Rate: 0 kg/ha ÷ 450 kg/ha x 50% stocking rate = **0 AUMs per hectare**

3.2 Primary and Secondary Ranges

Five basic range types are present in the Frances Creek Range Unit including improved range, cutblocks, grassland, open forests, and mature forests. Mature forest and cutblocks are the two largest range types within the range unit, distantly followed by open forest and grassland.

Herbage and forage production levels and grazing capacities for vegetation community types, and primary and secondary ranges in Hidden Valley, Franz, Brady, Elliot, and Height-of-Land Pastures are summarized in Table 3. Community Type 1 (Kentucky bluegrass/black medic-white clover) was confined largely to seeded landings that were too small to map. However, an estimate of total landing area, for primary and secondary range in each pasture, was determined with the aid of airphotos by counting the number of landings and multiplying by 0.25 hectares.

Table 3. Herbage and forage productivity (kg/ha) and carrying capacities for Hidden Valley, Franz, Brady, Elliot and Height of Land Pastures.

Pasture	Range	Community Type	Area (ha)	Grass (kg/ha)	Forbs (kg/ha)	Palatable Forbs[1] (kg/ha)	Forage (kg/ha)	Total Forage (kg/ha)	AUMs[2]
Hidden	Primary	CT1	16	1790	276	138	1928	30848	34
Valley		CT5	1194	505	361	0	505	602970	670
		CT6	25	1873	35	0	1873	46825	52
		Total	**1235**					**680643**	**756**
Franz	Primary	CT1	50	1790	276	138	1928	96400	107
		CT4	84	449	220	0	449	37716	42
		CT5	1645	505	361	0	505	830725	923
		CT6	44	1873	35	0	1873	82412	92
		Total	**1823**					**1047253**	**1164**
Brady	Primary	CT1	42	1790	276	138	1928	80976	90
		CT2	4	447	220	154	601	2404	3
		CT3	22	477	148	0	477	10494	12
		CT4	20	449	220	0	449	8980	10
		CT5	917	505	361	0	505	4630850	514
		CT6	46	1873	35	0	1873	86158	96
		Total	**1051**					**652097**	**725**

Pasture	Range	Community Type	Area (ha)	Grass (kg/ha)	Forbs (kg/ha)	Palatable Forbs[1] (kg/ha)	Forage (kg/ha)	Total Forage (kg/ha)	AUMs[2]
Elliot	Primary	CT1	40	1790	276	138	1928	77120	86
		CT2	37	447	220	154	601	22237	25
		CT3	221	477	148	0	477	105417	117
		CT4	44	449	220	0	449	19756	22
		CT5	12	505	361	0	505	6060	7
		Total	**354**					**230590**	**257**
	Secondary	CT3	66	477	148	0	477	31482	35
		Total	**66**					**31482**	**35**
Height-of-Land	Primary	CT1	12	1790	276	138	1928	23136	26
		CT2	132	447	220	154	601	79332	88
		CT3	562	477	148	0	477	268074	298
		CT4	1	449	220	0	449	449	1
		Total	**707**					**370991**	**413**

[1] Palatable forbs are black medic, white clover, alfalfa and yellow clover.
[2] AUM = (Total forage x 0.5) ÷ 50 kg.

Primary range in Hidden Valley, Franz, Brady, and Elliot Pastures is composed primarily of cutblocks and their associated access roads and landings. Primary range in Height-of-Land Pasture consists of grasslands, open forest areas, and cutblocks. Grassland areas in the other three pastures are relatively uncommon except along the Columbia River in Elliot Pasture. The widespread nature of primary range reflects, in part, the fact that water sources for livestock are well distributed throughout most of the range. Secondary range was limited to cutblock areas in Elliot Pasture where access to water for livestock was considered poor.

Eventually, as vegetation on cutblocks succeeds to a mature forest community, available forage will gradually decrease and these logged areas will revert to secondary or unutilized range. Some cutblocks that were harvested 20 years ago and subsequently replanted continue to have good forage production. Because of the open tree cover on these cutblocks, livestock movement is largely unimpeded.

3.3 Herbage and Forage Productivity

Forage production (kg/ha) for each community type (CT) is summarized in Table 4. Community types that have forage production greater than 1000 kg/ha include Kentucky bluegrass/black medic-white clover, sedge fen, and scrub riparian birch. The Kentucky bluegrass/black medic-white clover CT is found along logging access roads and landings, and re-seeded meadows. It is found in all pastures and although it forms a relatively small proportion of each pasture, it has high forage value for livestock. Sedge fen is commonly found around edges of small water bodies and is scattered throughout most of the range unit especially in Hidden Valley, Franz, and Brady Pastures. Although sedge fen has very high forage production, it is seldom grazed by livestock except opportunistically as livestock seek access to water.

Table 4. Forage production for community types in the Frances Creek Range Unit.

Community Type	Forage Production (kg/ha)
1. Kentucky bluegrass/black medic-white clover	1928
2. Junegrass/black medic-rosy pussytoes	601
3. Douglas-fir-lodgepole pine/kinnikinnick/pinegrass	477
4. Trembling aspen/kinnikinnick/pinegrass	449
5. Lodgepole pine/dwarf blueberry/pinegrass	505
6. Sedge fen	1873
7. Scrub birch-Labrador tea-shrubby cinquefoil	1599
8. Bunchberry/black huckleberry/Engelmann spruce	0

The riparian scrub zone occurs only intermittently along Frances Creek. Some riparian scrub areas appear to be heavily grazed by livestock while other areas appear only lightly grazed. Most riparian areas show a moderate level of trampling as livestock attempt to access Frances Creek. Although this narrow riparian scrub zone is intermittent, shrubs here have moderate to high cover. Prominent shrub species present, such as willow and red-osier dogwood, are important winter browse for moose and deer.

The pinegrass/dwarf blueberry/lodgepole pine CT has forage production between 500 and 1000 kg/ha. This is the most widespread rangeland CT and is characteristic of logged areas in early to intermediate stages of succession. Most of the available forage in this CT is composed of native grasses, predominantly pinegrass. Because the majority of sites sampled were less than 20 years post-harvest, the

effect of canopy closure on understory production is probably none to low. As succession proceeds and canopy closure increases, a decrease in forage production is anticipated in this CT.

Community types that have forage production less than 500 kg/ha include junegrass/black medic-rosy pussytoes, pinegrass/kinnikinnick/trembling aspen, pinegrass/kinnikinnick/Douglas-fir-lodgepole pine. The junegrass/black medic-rosy pussytoes CT is found on grasslands primarily in Height-of-Land Pasture on southerly exposures. Most of the available forage in this CT consists of native grasses, such as junegrass, western wheatgrass, Columbia needlegrass, and palatable forbs such as black medic. The pinegrass/kinnikinnick/trembling aspen CT occurs only sporadically in this range unit. Pinegrass forms most of the available forage in this CT. However, the relatively high proportion of preferred browse species, such as saskatoon and aspen, in this CT make it important for wildlife. The pinegrass/kinnikinnick/Douglas-fir-lodgepole pine CT is characteristic of open and closed forest communities in which native grasses, predominantly pinegrass, comprise most of the forage. Preferred browse species such as aspen and saskatoon are largely absent in this CT.

The bunchberry/black huckleberry/Engelmann spruce community type that is characteristic of extensive mature coniferous forests found along the west side of Franz and Hidden Valley Pastures has almost zero forage production and very low herbage production.

An important consideration in any range inventory is the effect that variations in annual precipitation have on herbage production, particularly with respect to rainfall. Researchers in Canada and the United States have reported vegetation is sensitive to variations in rainfall during the growing season (Smoliak 1956, Bennett et al. 1987, Rosiere 1987). Graminoids, and, to a lesser extent, forbs respond to increased rainfall between May and July by exhibiting increased growth rates. In mountainous areas, however, the effects of variations in annual rainfall are less clear, particularly as it relates to amount of snow melt, landscape position and presence of seepage areas. During the present study, the Frances Creek Range Unit received above-normal amounts of rainfall in May, June and July 1996 and below average rainfall amounts in August 1996. During June and July 1996, rainfall was almost 60 and 15% higher, respectively, than the 30-year normals recorded at Kootenay West Gate meteorological station (Figure 2). However, rainfall in August set a new record low with 89% less rainfall than the 30 year normal. As a result of higher June and July rainfall, herbage production levels were likely somewhat higher than normal, which raises the question about the extent to which herbage production measurements obtained in 1996 reflect the average levels that can be expected in the region over the long-term. Because of this, annual monitoring of the exclosure cages should be undertaken to accurately determine average production levels for use in establishing grazing capacities in the Frances Creek Range Unit.

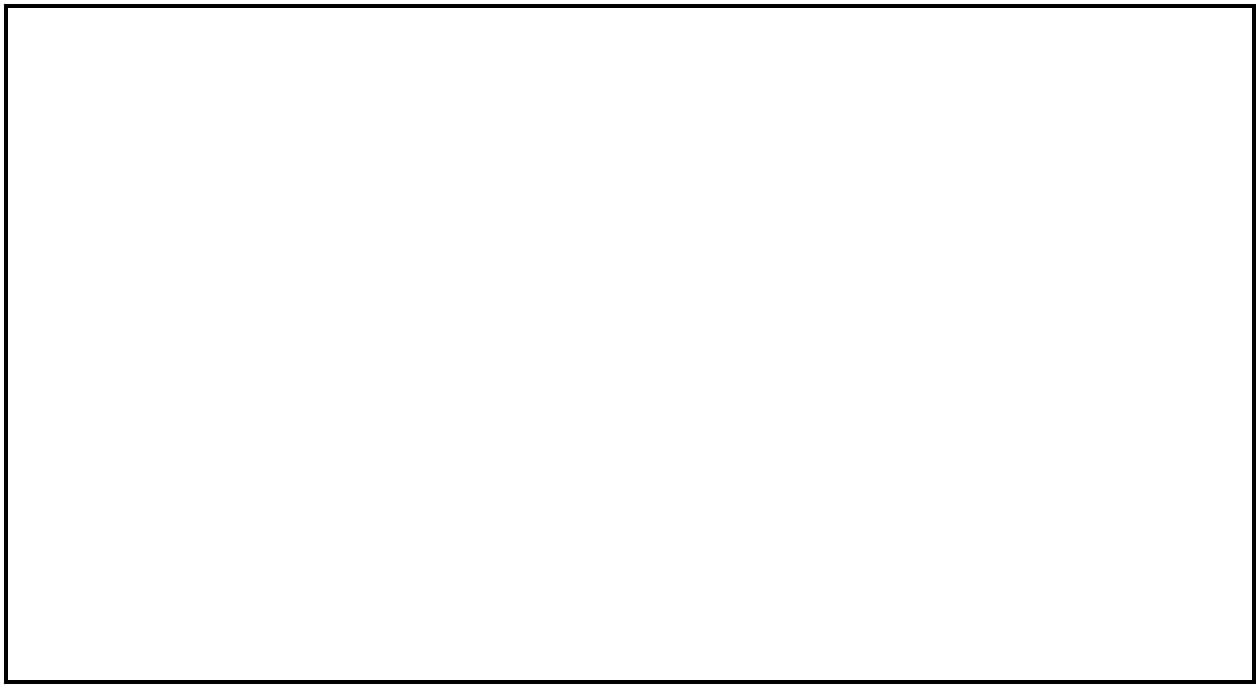

Figure 2. Monthly comparisons of 1996 rainfall with 30 year long-term normals, Kootenay West Gate meteorolgical station located in Kootenay National Park.

3.4 Range Management Considerations

3.4.1 Limiting Landscape Features

Domestic livestock use of the Frances Creek Range Unit is strongly influenced by topography, vegetation, and available stock water. Access to stock water for domestic livestock is generally good throughout Hidden Valley, Franz, Brady and Height-of-Land Pastures. Only in some areas of Elliot Pasture does grazing appear to be constrained by lack of access to water. Steep topography along the west side of the Columbia River makes livestock access to the river difficult. Steep topography and dense forest along the west slope of Steamboat Mountain and the east slope of the Purcell Mountain range are the main impediments to livestock grazing in this range unit. Closed forests generally provide little forage and are usually not used as range habitat. Extensive forest harvesting throughout the range unit has resulted in an expanded network of roads and trails that provide good rangeland access for livestock. Steep terrain does

not appear to hinder livestock movement as long as there is access by road or trail. Livestock are known to use the road system to climb to the top of Steamboat Mountain where they graze in clearcuts.

3.4.2 Patterns of Grazing Use

Presently, a herd of approximately 209 cows and 7 bulls has been grazing the Frances Creek Range Unit from early May until mid-October. Grazing rotation usually commences in Height-of-Land and proceeds to Franz, Brady, and Elliot Pastures. Hidden Valley Pasture at the north end of the range unit is grazed by another tenure holder as part of the Sunny Bench-Fish Lakes Range Unit.

Based on AUMs calculated for 1996 (Table 3), it would appear that livestock grazing on all pastures is below the current grazing capacity. Recent logging activities in Franz, Brady, and to a lesser extent, Elliot, probably ensure that there is sufficient rangeland for the current herd in the forseeable future. As forest cover gradually becomes re-established on harvested sites, forage production will gradually decline and access for livestock will become more difficult. Presently preferred areas will become less preferred and overall primary range will decrease. Assuming no new forest harvesting, carrying capacity on these pastures is expected to change over the next 10-30 years as forest succession proceeds on existing harvested areas.

Since current grazing levels are much lower than calculated carrying capacity, it is predicted that few if any areas would show signs of heavy grazing pressure. In general, this appears to be true except for open exposed grassland areas in Height-of-Land and Elliot Pastures where significant livestock and wildlife use likely occurs, especially if flies are bad. Also, some seeded landings in all pastures show signs of heavy grazing.

3.4.3 Poisonous Plants or Noxious Weeds

Timber milk-vetch was the only poisonous plant noted during the study. Although widespread, timber milk-vetch cover was generally very low. Potentially important noxious weeds including diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea maculosa*), and leafy spurge, (*Euphorbia esula*), were not observed in the range unit.

3.4.4 Ungrazed Sites For Potential Monitoring

All primary range within the Frances Creek Range Unit appears to have been grazed by livestock to some extent and no native rangeland communities could be considered pristine. However, a small exclosure in Height-of-Land Pasture presently protects an open woodland area of Douglas-fir and lodgepole pine from wildlife browsing and grazing.

3.4.5 Damaged Trails or Watering Areas

Trails throughout the Frances Creek Range Unit appear to be in relatively good condition. No damaged trails attributable to livestock were noted during the study. Heavy grazing and trampling was noted on some riparian areas along Frances Creek; however, most other watering areas showed only minor evidence of livestock use. In addition, no serious erosion was noted along observed trails or adjacent watering areas.

3.4.6 Access

Access for domestic livestock, throughout Frances Creek Range Unit, is generally good. All pastures are road accessible and numerous logging roads and trails provide good access to primary range within each pasture.

3.4.7 Wildlife Use

Based on observations of fecal groups during the range inventory, ungulate activity appears to be concentrated in grassland and open woodland areas, and to a much lesser extent in harvested cutblocks. Most of grassland areas are located in Height-of-Land Pasture and along the west banks of the Columbia River in adjacent Elliot Pasture. Height-of-Land Pasture, in particular, has extensive areas that have high value as wildlife habitat. Numerous small areas of grassland and adjacent open woodland provide critical winter range for elk and white-tailed deer, and important range for mule deer. This mix of exposed, open grass dominated areas and open forest with significant shrub cover provides ideal habitat for elk during the winter. Elk and/or deer pellets were noted on all grassland areas sampled. Open treed areas, especially aspen dominated sites are also important as wildlife habitat. Important browse species such as saskatoon and aspen often have high cover on these sites. Moose and elk pellet groups were frequently noted on aspen dominated sites, particularly in Height-of-Land Pasture. Good forage and browse were noted in the other pastures especially on recent post-harvest areas. However, pellet groups and evidence of browsing were seen much less frequently on these sites.

The degree of forage competition between elk and livestock on primary range was not determined in the present study. Maintaining levels of cattle grazing on primary range and leaving forage on secondary range for elk will reduce forage competition, but is unlikely to eliminate it completely. Moose and deer do not usually compete with livestock because they tend to use different types of forage and habitat. Management practices such as placing salt away from water should be continued to disperse cattle grazing pressure. Limiting stocking rates to grazing capacity provided by primary range will also ensure moderate levels of livestock use and will minimize forage competition between cattle and native ungulates.

4.0 RECOMMENDATIONS

Based on the range inventory conducted in 1996, a number of recommendations regarding range management in Frances Creek Range Range Unit can be made:

1. Controlled burns may be required in Height-of-Land and Elliot Pastures to control tree encroachment on grassland community types.

2. Because of above-normal rainfall experienced in 1996, levels of herbage production beneath the exclosure cages should be monitored for at least an additional three or four years. Appropriate adjustments to grazing capacities within the primary ranges of Hidden Valley, Franz, Brady, Elliot, and Height-of-Land Pastures can then be made.

3. Open, exposed grassland areas in Height-of-Land Pasture are beginning to show signs of grazing pressure. Efforts should be made to draw livestock away from these areas.

4. The present number of AUMs in all pastures of the Frances Creek Range Unit appear to be within their carrying capacity. Overall range conditions are good indicating that this level of use is sustainable. The main areas of concern are the grasslands in Height-of-Land and Elliot Pastures and riparian areas along Frances Creek where grazing pressures are apparent.

5. An on-going program to monitor range productivity and carrying capacity should be maintained with re-assessment conducted on a regular basis. Production and utilization plots should be clipped and assessed every two years.

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APPENDIX 1. Species list of plants recorded in the Frances Creek Range Unit, July, 1996.

Scientific Name	Common Name	Acronym
Abies lasiocarpa	subalpine fir	abielas
Acer glabrum	Douglas maple	acergla
Achillea millefolium	yarrow	achimil
Agropyron cristatum	crested wheatgrass	agrocri
Agoseris glauca	pale agoseris	agosgla
Alnus crispa	green alder	alnucri
Alnus incana	mountain alder	alnuinc
Amelanchier alnifolia	saskatoon	amelaln
Anaphalis margaritacea	pearly everlasting	anapmar
Anemone parviflora	northern anemone	anempar
Anemone multifida	cut-leaved anemone	anemmul
Antennaria microphylla rosy pussytoes	antemic	
Antennaria neglecta	field pussytoes	anteneg
Antennaria pulcherrima tall pussytoes	antepul	
Apocynum androsaemifolium	spreading dogbane	apocand
Arabis holbellii	Holboell's rockcress	arabhol
Aralia nudicaulis	wild sarsaparilla	aralnud
Arctostaphylos uva-ursi	kinnikinnick	arctuva
Arnica cordifolia	heart-leaved arnica	arnicor
Arnica fulgens	orange arnica	arniful
Artemisia frigida	pasture sage	artefri
Aster ciliolatus	fringed aster	astecil
Aster conspicuus	showy aster	astecon
Aster ericoides	tufted white prairie aster	asteeri
Aster hesperius	western willow aster	astehes
Aster laevis	smooth aster	astelae
Astragalus miser	timber milk-vetch	astrmis
Atriplex sp.		atri sp
Balsamorhiza sagittata arrow-leaved balsamroot		balssag
Betula glandulosa	scrub birch	betugla
Betula papyrifera	paper birch	betupap
Bromus inermis	smooth brome	bromine

Bromus tectorum	cheatgrass	bromtec
Calamagrostis canadensis	bluejoint	calacan
Calamagrostis rubescens	pinegrass	calarub
Calochortus apiculatus	threespot mariposa lily	caloapi
Caltha palustris	yellow marsh-marigold	caltpal
Campanula rotundifolia	common harebell	camprot
Carex sp.	sedge	care sp
Carex aquatilis	water sedge	careaqu
Carex aurea	golden sedge	careaur
Carex concinnoides	northwestern sedge	carecon
Carex interior	inland sedge	careint
Carex lanuginosa	woolly sedge	carelan
Carex utriculata	beaked sedge	careutr
Chimaphila umbellata	prince's pine	chimumb
Chrysothamnus nauseosus	common rabbit bush	chrynau
Clintonia uniflora	Queen's cup	clinuni
Campanula rotundifolia	common harebell	camprot
Chimaphila umbellata	Prince's pine	chimumb
Cirsium arvense	Canada thistle	cirsarv
Clematis occidentalis	Columbia bower	clemocc
Comandra umbellata	pale comandra	comaumb
Cornus canadensis	bunchberry	corncan
Cornus stolonifera	red-osier dogwood	cornsto
Dactylis glomerata	orchardgrass	dactglo
Deschampsia caespitosa	tufted hairgrass	desccae
Disporum trachycarpum	rough-fruited fairybells	disptra
Dodecatheon pulchellum	few-flowered shootingstar	dodepul
Elymus glaucus	blue wildrye	elymgla
Elymus repens	quackgrass	elymrep
Elymus smithii	western wheatgrass	elymsmi
Elymus trachycaulus	slender wheatgrass	elymtra
Epilobium sp.		epil sp
Epilobium angustifolium	fireweed	epilang
Equisetum arvense	common horsetail	equiarv
Equisetum scirpoides	dwarf scouring-rush	equisci

Erigeron caespitosus	tufted fleabane	erigcae
Erigeron filifolius	thread-leaved fleabane	erigfil
Erigeron pumilus	shaggy fleabane	erigpum
Festuca campestris	rough fescue	festcam
Festuca idahoensis	Idaho fescue	festida
Filago arvensis	field filago	filaarv
Fragaria virginiana	wild strawberry	fragvir
Galium boreale	northern bedstraw	galibor
Gentianella amarella	northern gentian	gentama
Geocaulon lividum	bastard toad-flax	geocliv
Glyceria striata	fowl mannagrass	glycstr
Goodyera oblongifolia	rattlesnake plantain	goodobl
Grindelia squarrosa	curly-cup gumweed	grinsqu
Hedysarum sulphurescens	yellow hedysarum	hedysul
Hieracium albiflorum	white-flowered hawkweed	hieralb
Hieracium umbellatum	narrow-leaved hawkweed	hierumb
Hippuris vulgaris	common mare's tail	hippvul
Juncus balticus	Baltic rush	juncbal
Juncus regelii	Regel's rush	juncreg
Juniperus communis	common juniper	junicom
Juniperus horizontalis	creeping juniper	junihor
Juniperus scopulorum	Rocky Mountain juniper	junisco
Koeleria macrantha	junegrass	koelmac
Ledum groenlandicum	Labrador tea	ledugro
Lepidium densiflorum	prairie pepper-grass	lepiden
Leucanthemum vulgare	oxeye daisy	leucvul
Linnaea borealis	twinflower	linnbor
Lithospermum ruderale	lemonweed	lithrud
Lomatium triternatum	narrow-leaved desert-parsley	lomatri
Lonicera involucrata	black twinberry	loniinv
Lycopodium annotinum	stiff clubmoss	lycoann
Lycopodium complanatum	ground-cedar	lycocom
Mahonia repens	creeping Oregon-grape	mahorep
Medicago lupulina	black medic	medilup
Medicago sativa	alfalfa	medisat

Melampyrum lineare	cow-wheat	melalin
Melilotus alba	white sweet-clover	melialb
Melilotus officinalis	yellow sweet-clover	melioff
Mitella nuda	common mitrewort	mitenud
Orthilia secunda	one-sided wintergreen	orthsec
Osmorhiza chilensis	mountain sweet-cicely	osmochi
Oryzopsis asperifolia	rough-leaved ricegrass	oryzasp
Oryzopsis pungens	short-awned ricegrass	oryzpun
Oxytropis sericea	silky locoweed	oxytser
Penstemon confertus	yellow penstemon	penscon
Phleum pratense	timothy	phlepra
Picea engelmannii	Engelmann spruce	piceeng
Picea glauca	white spruce	picegla
Picea mariana	black spruce	picemar
Pinus contorta	lodgepole pine	pinucon
Plantago patogonica	Indian-wheat	planpat
Platanthera hyperborea	green-flowered bog orchid	plathyp
Poa compressa	Canada bluegress	poa com
Poa palustris	fowl bluegrass	poa pal
Poa pratensis	Kentucky bluegrass	poa pra
Polygonum douglasii	Douglas' knotweed	polydou
Polygonum viviparum	alpine bistort	polyviv
Populus tremuloides	trembling aspen	poputre
Potentilla fruticosa	shrubby cinquefoil	potefru
Pseudotsuga menziesii	Douglas-fir	pseumen
Pyrola asarifolia	pink wintergreen	pyroasa
Pyrola chlorantha	arctic wintergreen	pyrochl
Ribes sp.	gooseberry	ribe sp
Ribes oxyacanthoides	northern gooseberry	ribeoxy
Ribes lacustre	black gooseberry	ribelac
Rosa acicularis	prickly rose	rosaaci
Rubus parviflorus	thimbleberry	rubupar
Rubus pubescens	trailing raspberry	rubupub
Salix sp.	willow	sali sp
Salix brachycarpa	short-fruited willow	salibra

Salix candida	hoary willow	salican
Salix maccalliana	Maccall's willow	salimac
Salix scouleriana	Scouler's willow	salisco
Schizachne purpurascens	false melic	schipur
Senecio pseudaureus	streambank butterweed	senepse
Senecio streptanthifolius	Rocky Mountain butterweed	senestr
Shepherdia canadensis soopolallie	shepcan	
Silene menziesii	Menzies' campion	silemen
Smilacina racemosa	false Solomon's seal	smilrac
Solidago spathulata	spike-like goldenrod	solispa
Sonchus sp.		sonc sp
Sonchus arvensis	perennial sow-thistle	soncarv
Spartina gracilis	alkali cordgrass	spargra
Spiraea betulifolia	birch-leaved spiraea	spirbet
Sporobolus sp.	dropseed	spor sp
Stellaria longifolia	long-leaved	starwort
Stipa comata	needle-and-thread grass	stipcom
Stipa nelsonii	Columbia needlegrass	stipnel
Stipa richardsonii	spreading needlegrass	stipric
Symphoricarpos albus common snowberry		sympalb
Symphoricarpos occidentalis	western snowberry	sympocc
Taraxacum officinale	common dandelion	taraoff
Tragopogon dubius	yellow salsify	tragdub
Trifolium hybridum	alsike clover	trifhyb
Trifolium pratense	red clover	trifpra
Trifolium repens	white clover	trifrep
Tsuga heterophylla	western hemlock	tsughet
Typha latifolia	common cattail	typhlat
Vaccinium caespitosum	dwarf blueberry	vacccae
Vaccinium membranaceum	black huckleberry	vaccmem
Vaccinium scoparium	grouseberry	vaccsco
Viburnum edule	highbush-cranberry	vibuedu
Vicia americana	American vetch	viciame
Viola sp.	violet	viol sp
Zygadenus elegans	mountain death-camas	zigaele

Mosses and Lichens

Aulacomnium spp.	aulaspp
Brachythecium spp.	bracspp
Ceratodon spp.	ceraspp
Cetraria spp.	cetrspp
Campylium spp.	campspp
Cladonia spp.	cladspp
Dicranum spp.	dicrspp
Drepanocladus spp.	drepspp
Hylocomium spp.	hylospp
Marchantia spp.	marcspp
Peltigera spp.	peltspp
Pleurozium spp.	pleuspp
Pohlia spp.	pohlspp
Polytrichum spp.	polyspp
Ptilium spp.	ptilspp
Tomenthypnum spp.	tomespp