AN ASSESSMENT OF THE CARRYING CAPACITY IN THE STEAMBOAT RANGE UNIT

prepared for the
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Invermere, B.C.

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1.0 INTRODUCTION

Rangelands are an important resource in British Columbia. Forested range, e.g., forage crops, improved pasture, native range and community pastures, cover about 11 million hectares, most of which is Crown land. Crown range accounts for approximately 85% of the area used for grazing in the province (Ministry of Forests 1994).

The importance of Crown range cannot be overemphasized. During the recording period of 1989 to 1990, almost one million animal unit months (AUMs) or 60% of the total forage requirements for beef production in the province was produced on Crown lands (Meidinger and Pojar 1991). Although the Nelson Forest Region has a modest number of domestic livestock Animal Unit Months (AUMs) (84,667 net authorized), it has a high number of wildlife AUMs (Ministry of Forests 1994). Rangelands also provide important fish and wildlife habitat, recreational opportunities and aesthetic appeal in addition to beef production (Meidinger and Pojar 1991).

Logging activities and fire are important factors in the conversion of forest into rangelands (Dodd et al. 1972). Because a significant portion of Crown range is forested, the influences of timber harvesting must be considered and planned for in range management activities.

Rangeland management is the responsibility of the British Columbia Ministry of Forests (Nordstrom 1984). Within the Forest Service, the Range Section issues grazing tenures and hay cutting permits for domestic livestock, monitors tenure compliance and conducts inventories. Because of the importance of rangelands to other users, the Ministry of Environment is also involved in rangeland management and planning. In 1989, the Range Program Review Task Force recommended that a range inventory program be implemented to document the carrying capacities of rangelands (Ministry of Forests 1989). A range use plan is developed from the range inventory, the purpose of which, is to provide direction and guidelines to the range tenure holder as well as the Ministry of Forests. Specifically, the range use plan describes management practices which will ensure the long-term ‘health’ and productivity of rangelands (Ministry of Forests 1994).

Within the requirements of the Forest Practices Code Act, the Ministry must also assess Existing Plant Communities (EPC), and where necessary, provide management directives for Desired Plant Communities (DPCs) (British Columbia Ministry of Environment 1995a). Biodiversity and riparian area management are also important considerations in rangeland management (British Columbia Ministry of Environment 1995b, 1995c).

As part of a continuing range management program, the Range Section of the Invermere Forest District determined that a forage assessment of the Steamboat

Range Unit was warranted. The following report, prepared by Environmental Insight, presents the results of this forage assessment. The information contained within this report will assist resource managers in developing and implementing management plans that will ensure sustained forage yields for domestic livestock and wildlife while ensuring compatability with other land uses.

1.1 Objectives

The overall objectives of the study were two-fold: (1) to determine species composition and percent cover (as well as other site attributes) for an evaluation of site condition and (2) to acquire forage productivity data for allocation of carrying capacity. Specific objectives of the Steamboat Range Unit 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 Steamboat Range Unit is located in the Rocky Mountain Trench on the west side of the Columbia River, approximately 10 kilometers northwest of Radium Hot Springs. The western boundary of the range unit is located along the ridge of Steamboat Mountain and extends from the northern end of the mountain to Lot 348 at the southern end. The eastern boundary is the Columbia River. The range unit covers approximately 3,830 hectares, of which, 183 hectares or 5% of the total area is private land (Table 1). The Steamboat Range Unit is separated into two pastures, Tea Kettle and Red Rock.

Table 1. Area (ha) of private and Crown lands in the Steamboat Range Unit.

Pasture	Total Area (ha)	Private Lands (ha)	Crown Lands	
			Utilized (ha)[1]	Unutilized[2] (ha)
Red Rock	1251.0	130.0	467.3	653.7
Tea Kettle	2579.0	49.7	1000.3	1529.0

1 Livestock use focused primarily on these areas, also used by wildlife.

2 Areas largely ususued by livestock. Consists primarily of forested lands.

1.3 Pastures of the Steamboat Range Unit

The Steamboat Range Unit is located within three of the six biogeoclimatic zones described for the Nelson Forest District by Braumandl and Curran (1992). The Interior Douglas-Fir (dry/mild) Zone (IDF) occupies the lower elevations of the range unit while the Montane Spruce Zone (MS) occupies the middle elevations and the Engelmann Spruce - Subalpine Fir Zone (ESSF) occupies the higher elevations.

2.0 METHODS

2.1 Preliminary Investigations

A preliminary assessment of broad plant communities based on airphotos and field checks was completed for the Steamboat Range Unit in 1995 (Ministry of Forests 1996).

Preliminary range types were mapped using 1:20,000 scale color or black-and-white aerial photographs and 1:20,000 forest cover maps prior to the 1996 field survey. A reconnaissance-level field trip of the Tea Kettle and Red Rock pastures was undertaken with the range resource officer to obtain an overview of the community types and grazing practices. Sampling effort for the vegetation and range survey was then stratified and 22 transects were assigned within the two pastures. Transect locations were marked on aerial photographs and maps to facilitate classification and delineation of community types. In addition, an overview of current and past management practices and issues or concerns was obtained by completing an interview with the range unit tenure holder.

2.2 Vegetation Survey

A vegetation survey designed to document species composition and percentage cover was conducted between June 17 - July 22, 1996 using sampling methods described in Alberta Forest Service's Range Survey Manual (Alberta Forest Service 1990). Vegetation was sampled on 15 microplots placed randomly along twenty-two 30 m transects. At each microplot location, a 1 x 1 m plot was used for shrubs and a nested 20 x 50 cm microplot was used for grasses and forbs. A single 20 x 20 m macroplot was located at the centre of the transect to estimate the canopy coverage of trees and tall shrubs (stems>2.5 m). The canopy coverage method of Daubenmire (1959) was used for plot sampling.

The vegetation inventory was completed in all deciduous forest stands and those coniferous stands with less than 35 percent tree cover. Transects were located in broadly representative locations. Transects located in sloping terrain were positioned parallel to slope contours.

Cover estimates for all species found within the microplots were recorded to the nearest 5% when cover exceeded 5% cover. Cover estimates for species with

values between 0 and 5% were recorded 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 British Columbia Ministry of Forests.

Evidence of wildlife utilization included indirect 'sign' observations, e.g., sounds, homesite, browse utilization, territorial markings, excavations and pellet group counts. Method 1 of Luttmerding et al. (1990) was used for the pellet counts. Subplots 4.7 m in diameter circular plot were positioned at the center of the macroplot and 20 m away at each of the cardinal directions (N, S, E and W). 'Signs' or indirect evidence of wildlife presence were part of the general site descriptions as well.

For each transect/macroplot, the existing vegetation was documented by photographing the transect, as viewed from one end, and by photographing a representative microplot from above. Transect position coordinates (UTM latitude and longitude) were recorded with a hand held Garmin™ 45 (accuracy 15 m) Global Positioning System (GPS) unit. The GPS coordinates will be used for the relocation of the transects in the future.

Range condition was estimated through visual comparisons with adjacent ungrazed areas (Alberta Forest Service 1990) or additional vegetation plots located in 'climax' stands.

2.3 Forage Production

A major objective of the study was to collect forage production data for use in calculating carrying capacities for the Steamboat Range Unit. Herbage production and forage use levels within a range type are typically determined by harvesting vegetation from within range cage exclosures and from non-exclosure at each transect (Bonham 1989). In the present study, Ministry of Forests forage production exclosures were constructed from 2.54 cm^2 wire mesh and were used to prevent herbivore grazing from an area of approximately 1.25 m^2.

Steamboat Range Unit forage production assessments were completed on August 13 - 14, 1996. At each transect, a representative 50 x 100 cm rectangular quadrat or sampling unit was clipped to a height of 2 centimeters. When present, another clip was made within the exclosure cage. Litter was removed and bagged prior to clipping. The clipping material was separated into shrubs (<2.5m) grasses (and grass-like vegetation) and forbs and placed into labelled bags for drying. Only the current year's growth of shrubs was clipped (Bonham 1989).

Historical and current information relevant to range management planning, e.g., salting, livestock distributions, classes of livestock, grazing system, access, season of use, wildlife use and fires (Nordstrom 1984), was obtained from

Ministry of Forest documents and a personal interview completed with the tenure holder.

2.4 Laboratory Methods and Data Analysis

Floristic and site description data for each quadrat were input into Microsoft Excel files, converted into Lotus 123 WK1 files and analyzed with the PC-ORD suite of software program. The reliability and accuracy of the data entry procedures was verified prior to analysis. Mean species percent cover values were calculated for each transect following data entry. Transect data were 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 (McCune and Mefford 1995). 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. As well, the software programs COENOS (Cêska and Roemer 1978) and CLUSTER (McCune and Mefford 1995) were used for vegetation classification. Indirect gradient analysis was performed on the vegetation data using Non-Metric Multidimensional Scaling (NMDS) (Kent and Coker 1994) to examine the latent structure of the vegetation data and assist in the interpretation of the classification (Uresk 1990). Species/environment relationships, which are useful for examining range condition, were explored using the Canonical Correlation Analysis (CANOCO) software of ter Braak (1988).

Alpha diversity (within community or habitat) and, where appropriate, beta diversity (compositional changes between biotic assemblages along a gradient) (Baev and Penev 1993) were calculated.

Herbage production clips were provided to the Ministry of Forests Invermere Forest Distrct Office. Forest Service personnel then oven-dried and weighed the samples to the nearest 0.1 gram. Production (kg/ha) was calculated from raw data (g/0.5 m^2) using a conversion factor (x20). Herbage production data for were then input into a Microsoft Excel spreadsheet and the average of all clipped plots within each range type was calculated. AUMs were calculated using the formula described by (Gayton 1993, Heady and Child 1994).

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 of all range types was, for the most part, considered to be unpalatable. However, some forbs such as black medic (*Medicago lupulina* L.) were considered to be palatable to domestic livestock and were considered part of the calculation.

2.5 Calculating Carrying Capacity

Calculation of carrying capacity involves stratification of the landscape into primary, secondary and non-use ranges. 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 restricts livestock grazing and may include steep slopes, barriers to grazing such as thick brush, long distances to water or a plant community that does not contain palatable forage species (Stoddart et al. 1975). Carrying capacity for livestock should not include forage growing on secondary range since this could result in overstocking the primary range, particularly if there is no range rider. Non-use areas or tertiary range are those areas that contain significant barriers to movement such as excessive amounts of deadfall, steep slopes and/or the absence of palatable forage (Alberta Forest Service 1990).

Range condition was estimated through visual comparisons with adjacent ungrazed sites 'climax,' additional plots in 'climax' stands and, where available, with ecological classification literature for 'climax' communities.

Primary and secondary ranges were furthered subdivided into vegetation community types. Vegetation community types were characterized by areas exhibiting uniform species composition and herbage production levels. Productivity was then estimated for each community type, and a weighted mean (weighed by area) of herbage production of primary and secondary range was calculated. Unpalatable herbage was subtracted from herbage to calculate forage available for domestic livestock. A safe use factor was also applied to available forage and defined as a level of grazing that vegetation can withstand indefinitely without lasting detrimental effects. A safe use factor typically applied in grazing inventories of native rangelands reflects 50% of the use of available forage during the growing season. For example, 50% of herbage is allocated for plant recovery while use of the remaining 50% is allocated between wildlife and livestock. In general, swards revegetated with agronomics can withstand a higher level of use of growing season herbivory (60%) than native grass swards. However, considerably higher utilization levels can be accommodated during the dormant season (Stoddart et. al. 1975).

In the present study, available forage for domestic livestock for each community type in the range unit was estimated using the following relationship:

Herbage Production (Primary Range) - Unpalatable herbage - 50% Safe Use Factor.

Since 1 AUM (cow/calf pair) is equal to 450 kg of forage (Basarab 1987) carrying capacity (in AUMs for livestock) can be calculated. All AUMs in this report refer to cow/calf pairs only. Since calculations of wildlife carrying capacity were beyond the scope of the present study, no adjustments for wildlife species AUM values and primary and secondary range map unit were made.

3.0 RESULTS AND DISCUSSION

3.1 Community Type Descriptions

Nine plant community types were classified for the Steamboat Range Unit. A total of 206 plant species were recorded within the study area, i.e., 6 trees, 33 shrubs 11 rushes and sedges, 26 grasses, 104 forbs, 15 mosses, 2 liverworts and 9 lichens. Vascular plant species identification followed Douglas et al. (1989, 1990, 1991, 1994) and moss and lichen identification followed Vitt et al. (1988).

The presence of rare or endangered species was determined by comparing the study area species list with the British Columbia Conservation Data Centre's *1995 Tracking List for Vertebrate Animals, Vascular Plants and Plant Communities*. Although none of the species listed in Appendix 2 were on the provincial list, sub-species of five study area species are listed. For example, the blue-listed varieties or sub-species of Holboell's rockcress (*Arabis holboellii* var. *collinsii* [Fern.] Roll.), western mugwort (*Artemesia ludoviciana* var. *incompta* [Nutt.] Cronq.) and purple-leaved willowherb (*Epilobium ciliatum* ssp. *watsonii* [Barbey] Hoch & Raven) may be present while the red-listed varieties or sub-species of slender hawksbeard (*Crepis atrabarba* ssp. *atrabarba* Heller) and northern gooseberry (*Ribes oxycanthoides* ssp. *cognatum* Greene) may be present as well. The presence of rare or endangered species within the study area should be examined further.

The vegetation within the study area is controlled by three dominant parameters as determined by Canonical Correlation Analysis (ter Braak 1988) and Non-Metric Multidimensional Scaling. Intraset correlations of vegetation and environmental variables, showed that moisture (R = 0.77 on axis 1), elevation (R = 0.83 on axis 2) and slope (R = 0.78 on axis 3) were the main determinants of the environmental variables sampled. However, eigenanalysis indicated that these three variables only acccounts for 30.9% of the latent structure determining vegetation distribution.

All of the delineated community types and corresponding sample plots are listed in Table 2. Wildlife observations are listed in Appendix 4.

Species diversity (Table 3) varies considerably. Richness R varies from 55 for the Douglas Fir Bluebunch Wheatgrass community type to 14 for the Water Sedge - Soft-Stemmed Bulrush Community Type. Evenness (J) is also variable, but less than the variability recorded for species richness. Diversity is relatively high in all the plant communities delineated except for the Water Sedge - Soft-Stemmed Bulrush type.

Table 2. Vegetation community types found in the Steamboat Range Unit.

Community Type	Plot Numbers
1. Western Mugwort/Awned Hair Cap Moss	19, 20
2. Douglas Fir / Bluebunch Wheatgrass	4, 18
3.Canada Bluegrass / White Clover	12
4. Trembling Aspen / Northern Bedstraw	8, 10, 11, 22
5. Birch-Leaved Spirea / Fireweed	1, 2, 3, 7, 13, 17
6. Heart-Leaved Arnica - Twinflower	6, 15, 16
7. Common Dandelion / Black Medic	14
8. Orchard Grass - Canada Bluegrass	5, 9
9. Water Sedge - Soft-Stemmed Bulrush	21

Table 3. Species diversity for the plant communities in the Steamboat Range Unit.

Community Types	Richness *R*	Evenness *J*	Diversity *H'*
1. Western Mugwort /Awned Hair Cap Moss	22 - 24	0.803	2.516
2. Douglas Fir / Bluebunch Wheatgrass	50 - 55	0.791	3.129
3. Canada Bluegrass / Common Yarrow	40	0.768	2.834
4. Trembling Aspen / Northern Bedstraw	32 - 50	0.847	3.180
5. Birch-Leaved Spirea / Fireweed	43 - 54	0.781	3.005
6. Heart-Leaved Arnica - Twinflower	40 - 47	0.796	3.015
7. Common Dandelion / Black Medic	14	0.689	1.182
8. Orchard Grass - Canada Bluegrass	34	0.767	2.704
9. Water Sedge - Soft-Stemmed Bulrush	39 - 48	0.785	2.962

Each of the delineated plant community types are described in the following text and checksheets.

Community Type 1 (N = 2). Western Mugwort / Awned Hair Cap Moss (Photo 1).

This natural grassland community type has a limited distribution in the study area and is confined to sub-xeric sites. Short-awned porcupine grass (*Stipa curtiseta* A.S. Hitchc.) and needle-and-thread grass (*Stipa comata* Trin. & Rupr.) are the dominant and co-dominant grass species while western mugwort (*Artemesia ludoviciana* Nutt.) is the dominant forb. In general, this community type is surrounded by multiple-aged Douglas fir *(Pseudotsuga menziesii* var. *glauca* [Biessen.] Franco) stands.

Typically, this community type is found on south-facing upper-slope or crest mesoslope positions. The ecological moisture regime ranges between sub-xeric or xeric and the ecological nutrient regime is sub-mesotrophic. The soils of this community type have a silt-loam texture, few coarse fragments and a soil pH of 8 within the main rooting zone. Litter and humus cover 35 to 45 percent of the surface substrate. The substrate generally has between 50 and 60 percent exposed mineral soil.

This community type is utilized extensively by elk (*Cervus elaphus* Linnaeus) and cows and receives moderate use by hares (*Lepus americanus* Erxleben) and columbian ground squirrels (*Spermophilus columbianus* Ord). In general, good hiding/thermal cover is present within short distances while distance to water is 500 - 600 meters away. These communities may be important for elk winter range. Considerable evidence of animal traffic induced soil erosion frequently is present.

Representative Site(s): Plots 19 and 20
Landscape Position: Upper Slope
Elevation: 860 - 890 m
Slope: 38 - 40%
Aspect: 170 - 180º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Stipa curtiseta	Short-Awned Porcupine Grass	11
Stipa comata	Needle-and-thread-grass	4
Poa compressa	Canada Bluegrass	3
Poa pratensis	Kentucky Bluegrass	1
Forbs		
Artemesia ludoviciana	Western Mugwort	6
Artemesia frigida	Pasture Sage	5
Heterotheca villosa	Hairy Golden Aster	2
Calochortus macrocarpus	Sagebrush Mariposa	1

Shrubs

Rosa acicularis	Prickly Rose	1

Production (kg/ha):

Grasses	229.3*
Forbs	259.2*
Shrubs	2.5*
Total	491.0* Estimate

Stocking Rate: 229.3 kg/ha ÷ 450 kg/ha x 50% safe use = **0.26 AUMs per hectare.**

* Production cages were not present in this community type. Production values are based on utilization plots only.

Photo1. Community Type 1 Western Mugwort/Awned Hair Cap Moss

Community Type 2 (N = 2) Douglas Fir / Bluebunch Wheatgrass (Photo 2)

This community type is characteristic of dry open Douglas forests. The stands of this type are multiple-aged and have a history of partial cutting. Stand structure is affected by windthrow. The understory is open with scattered shrubs. The dominant shrub species is Rocky Mountain juniper (*Juniperus scopulorum* Sarg.).

The ecological moisture regime ranges between sub-xeric and sub-mesic while the ecological nutrient regime is typically sub-mesotrophic. The soils of this community type have a silt-loam texture typically and a soil pH that ranges between 7 - 8 within the main rooting zone. Litter and humus cover 75 to 85 percent of the surface substrate, dead wood covers 10 to 15 percent and exposed mineral soil comprises 5 to 10 percent.

This community type is used extensively by cows and several wildlife species. Mule deer (*Odocoileus hemionus* Rafinesque) and elk make moderate to heavy use of this type. Many of the shrubs are browsed heavily. Hares, squirrels, cougars (*Felis concolor* Linnaeus) and black bears (*Ursus americanus* Pallas) are also present in this community type. Bears feed extensively on ants in decaying logs and stumps within this type. These habitats may be important winter range for ungulates.

Representative Site(s): Plots 4 and 18
Landscape Position: Terrace
Elevation: 860 - 870 m
Slope: 10%
Aspect: 30 - 40º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Agropyron spicatum	Bluebunch Wheatgrass	4
Calamagrostis rubescens	Pine Grass	3
Festuca idahoensis	Idaho Fescue	3
Koeleria cristata	June Grass	2
Forbs		
Aster conspicuus	Showy Aster	8
Astragalus miser	Timber Milkvetch	2
Anemone multifida	Cut-Leaved Anemone	2
Gaillardia aristata	Gaillardia	2
Heterotheca villosa	Hairy Golden Aster	2
Shrubs		
Juniperus scopulorum	Rocky Mountain Juniper	6
Arctostaphylos uva-ursi	Bearberry	3

Rosa gymnocarpa	Baldhip Rose	3
Amelanchier alnifolia	Saskatoon	2

Production (kg/ha):

Grasses	111.6*
Forbs	404.9*
Shrubs	451.1*
Total	967.6* Estimate

Stocking Rate: 111.6 kg/ha ÷ 450 kg/ha x 50% safe use = **0.12 AUMs per hectare.**

* Production cages are not present in this community type. Production values are based on utilization plots only.

Photo 2. Community Type 2 Douglas Fir / Bluebunch Wheatgrass

Community Type 3 (N = 1) Canada Bluegrass / White Clover (Photo 3)

This open meadow community type is characteristic of habitats adjacent to riparian areas that are used extensively by cattle. These plant communities are surrounded by mixed stands of Douglas, trembing aspen (*Populus tremuloides* Michx.) and lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.). Agronomic species such as Canada bluegrass (*Poa compressa* L.), Kentucky bluegrass (*Poa pratensis* L.) and white clover (*Trifolium repens* L.) dominate the flora of this community type.

The ecological moisture regime is mesic and ecological nutrient regime is mesotrophic. The soils of this community type typically have a silt-loam texture and a soil pH of 7 - 8 within the main rooting zone. Litter and humus cover 80 percent of the surface substrate while rocks and exposed mineral soil comprise 20 percent. The parent material is a stony glacial till.

This community type experiences extensive use by cattle but only limited use by elk (winter) and mule deer (summer). Cow scats (cowpies) are present everywhere. The palatable species found in this community type are grazed extensively. The noxious weed common hound's tongue (*Cynoglossum officinale* L.) occurs in this community type.

Representative Site: Plot 12
Landscape Position: Lower Slope - Terrace
Elevation: 980 m
Slope: 10%
Aspect: 130º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Poa compressa	Canada Bluegrass	15
Poa pratensis	Kentucky Bluegrass	14
Poa palustris	Fowl Bluegrass	10
Stipa richardsonii	Richardson's Needlegrass	10
Forbs		
Trifolium repens	White Clover	12
Medicago lupulina	Black Medic	8
Agoseris glauca	Pale Agoseris	6
Arabis glabra	Towermustard	4
Achillea millefolium	Common Yarrow	2
Lithospermum ruderale	Lemonweed	1
Taraxacum officinale	Common Dandelion	1
Astragalus miser	Timber Milkvetch	1
Leucanthemum vulgare	Oxeye Daisy	1
Cynoglossum officinale	Common Hound's Tongue	1
Shrubs		

Symphoricarpos albus	Common Snowberry		6
Juniperus scopulorum	Rocky Mountain Juniper	1	
Juniperus communis	Common Juniper		1
Rosa gymnocarpa	Baldhip Rose		1

Production (kg/ha):

Grasses	1221.2
Forbs	998.4
Shrubs	2.2
Total	2221.8

Stocking Rate: 1221.2 kg/ha ÷ 450 kg/ha x 50% safe use = **1.36 AUMs per hectare.**

Photo 3. Community Type 3 Canada Bluegrass / Common Yarrow

Community Type 4 (N = 4) Trembling Aspen / Northern Bedstraw (Photo 4)

This community type is characteristic of open forest or previously forested areas that have either been partially cut or completely clearcut and are now in the early stages of regeneration. In general, the stands of this type are young seral trembling aspen dominated cutblocks.

The ecological moisture regime of this type ranges between sub-xeric and sub-mesic and ecological nutrient regime is typically mesotrophic. The soils of this community type have a silt-loam texture typically and a soil pH that ranges from 7 - 8. Litter and humus cover 80 to 90 percent of the surface substrate, dead wood covers 10 to 15 percent and rocks and/or mineral soil comprise 5 to 10 percent.

Domestic and non-domestic animal use of this community type is variable. Cattle use ranges from low to high with accessible areas utilized heavily. Trampling of the soil is extensive where cattle use was heavy. Light to moderate use by mule deer, elk and hares is common in this community type. Numerous black bear 'ant-log' excavations are present.

Representative Site(s): Plots 8, 10, 11 and 22
Landscape Position: Lower - Mid-slope
Elevation: 995 - 1205 m
Slope: 2 - 23%
Aspect: 60 - 230º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Calamagrostis rubescens	Pine Grass	13
Poa pratensis	Kentucky Bluegrass	4
Poa compressa	Canada Bluegrass	1
Festuca rubra	Creeping Red Fescue	1
Oryzopsis asperifolia	Rough-Leaved Ricegrass	1
Carex conncinoides	Northwest Sedge	1
Forbs		
Aster conspicuus	Showy Aster	5
Galium boreale	Northern Bedstraw	2
Achillea millefolium	Common Yarrow	2
Fragaria virginiana	Wild Strawberry	2
Aster ciliolatus	Fringed Aster	1
Arnica cordifolia	Heart-Leaved Arnica	1
Astragalus miser	Timber Milkvetch	1
Hedysarum sulphurescens	Sulfur Hedysarum	1
Shrubs		
Shepherdia canadensis	Soapberry	7
Amelanchier alnifolia	Saskatoon	5

Mahonia aquifolium	Tall Oregon Grape	4
Rosa gymnocarpa	Baldhip Rose	4
Symphoricarpos albus	Common Snowberry	3
Arctostaphylos uva-ursi	Bearberry	2
Acer glabrum	Douglas Maple	1
Betula occidentalis	Red Birch	1
Spirea betulifolia	Birch-Leaved Spirea	1
Juniperus communis	Common Juniper	1

Production (kg/ha):

Grasses	282.8
Forbs	777.9
Shrubs	248.7
Total	1309.4

Stocking Rate: 282.8 kg/ha ÷ 450 kg/ha x 50% safe use = **0.31 AUMs per hectare.**

Photo 4. Community Type 4 Trembling Aspen / Northern Bedstraw

Community Type 5 (N = 6) Birch-Leaved Spirea / Fireweed (Photo 5)

This community type is widely distributed and characteristic of seral cutblock stands logged 6 to 25 years ago. Pine grass (*Calamagrostis rubescens* R.Br.), showy aster (*Aster conspicuus* Lindl. in Hook.) and soapberry (*Shepherdia canadensis* [L.] Nutt.) dominate the stands of this community type.

The ecological moisture regime of this community type ranges between sub-xeric and mesic while the ecological nutrient regime ranges between sub-mesotrophic and mesotrophic. The soils of this type have a sandy loam texture and a soil pH of 6.5 - 8 within the primary rooting layer. Litter and humus cover 70 to 80 percent of the surface substrate, dead wood covers 5 to 10 percent and rocks and mineral soil comprise 5 to 10 percent.

Ungulate utilization of this community type ranges from light to moderate. Mule deer are the primary ungulate users of this community type and utilize these habitats during late fall and early winter. Elk make light use of these habitats. Cows do not appear to graze in this type. Hares and ruffed grouse (*Bonasa umbellus* Linnaeus) use this community type to a moderate extent. All of the sample plots contain decaying logs which black bears have excavated in search of ants.

Representative Site: Plots 1, 2, 3, 7, 13 and 17
Landscape Position: Mid-slope - Upper Slopes
Elevation: 1280 - 1360 m
Slope: 7 - 36%
Aspect: 10 - 90º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Calamagrostis rubescens	Pine Grass	20
Elymus glaucus	Blue Wild Rye	2
Carex concinnia	Low Northern Sedge	1
Carex concinnoides	Northwest Sedge	1
Forbs		
Aster conspicuus	Showy Aster	12
Hedysarum sulphurescens	Sulfur hedysarum	4
Epilobium angustifolium	Fireweed	3
Fragaria virginiana	Wild Strawberry	3
Linnea borealis	Twinflower	3
Gentianella amarella	Northern Gentian	2
Arnica cordifolia	Heart-Leaved Arnica	1
Linnea borealis	Twinflower	1
Antennaria racemosa	Raceme Pussy-Toes	1
Shrubs		

Shepherdia canadensis	Soapberry	7
Rosa gymnocarpa	Baldhip Rose	5
Betula occidentalis	Red Birch	4
Symphoricarpos albus	Common Snowberry	3
Spirea betulifolia	Birch-Leaved Spirea	2
Amelanchier alnifolia	Saskatoon	2
Vaccinium scoparium	Grouseberry	1
Mahonia aquifolium	Tall Oregon Grape	1

Production (kg/ha):

Grasses	565.8*
Forbs	823.8*
Shrubs	166.6*
Total	1556.2* Estimate

Stocking Rate: 565.8 kg/ha ÷ 450 kg/ha x 50% safe use = **0.63 AUMs per hectare.**

* Production cages are not present in this community type. Production values are based on utilization plots only.

Photo 5. Community Type 5 Birch-Leaved Spirea / Fireweed

Community Type 6 (N = 3) Heart-Leaved Arnica - Twinflower (Photo 6)

This community type is found at higher elevations and is characteristic of early, i.e., 5 to 10 year old, seral cutblock stands. The vegetation is dominated by pine grass, heart-leaved arnica (*Arnica cordifolia* Hook.), showy aster and soapberry. The plots which represent this community type had the greatest diversity of shrubs (13 - 18) in the study area.

The ecological moisture regime in this community type ranges between sub-mesic and mesic while the ecological nutrient regime ranges between sub-mesotrophic and mesotrophic. The soils of this type have sandy loam textures and a soil pH of 6.5 - 7 within the primary rooting layer. Litter and humus cover 60 to 80 percent of the surface substrate while dead wood covers 7 to 30 percent.

Mule deer and black bear are the primary wildlife species utilizing the stands of this community type. Only at lower elevations in this type is there evidence of cattle utilization. The occurrence of large numbers of berry-producing shrubs makes this plant community desirable for bears.

The infrequent presence of mountain death camas (*Zigadenus elegans* Pursh.) and timber milkvetch (*Astragalus miser* Dougl.) may be problematic for wildlife using stands of this community type.

Representative Site(s): Plots 6, 15 and 16
Landscape Position: Lower - Upper Slopes
Elevation: 1255 - 1570 m
Slope: 5 - 25%
Aspect: 50 - 70º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Calamagrostis rubescens	Pine Grass	8
Trisetum spicatum	Spike Trisetum	1
Carex concinnoides	Northwest Sedge	1
Carex concinnia	Low Northern Sedge	+
Forbs		
Arnica cordifolia	Heart-Leaved Arnica	11
Aster conspicuus	Showy Aster	8
Cornus canadensis	Ground Dogwood	7
Antennaria racemosa	Raceme Pussy-Toes	4
Fragaria virginiana	Wild Strawberry	4
Linnea borealis	Twinflower	2
Hieracium umbellatum	Narrow-Leaved Hawkweed	1
Gentianella amarella	Northern Gentian	1

Shrubs

Shepherdia canadensis	Soapberry	8
Acer glabrum	Douglas Maple	3
Lonicera involucrata	Black Twinberry	2
Spirea betulifolia	Birch-Leaved Spirea	2
Mahonia aquifolium	Tall Oregon Grape	1
Betula occidentalis	Red Birch	1
Arctostaphylos uva-ursi	Bearberry	1
Lonicera utahensis	Utah Honeysuckle	1

Production (kg/ha):

Grasses	432.3*
Forbs	878.1*
Shrubs	997.6*
Total	2308.0* Estimate

Stocking Rate: 432.3 kg/ha ÷ 450 kg/ha x 50% safe use = **0.48 AUMs per hectare.**

* Production cages are not present in this community type. Production values are based on utilization plots only.

Photo 6. Community Type 6 Heart-Leaved Arnica - Twinflower

Community Type 7 (N = 1) Common Dandelion / Black Medic (Photo 7)

This community type is restricted to few small patches of disturbed vegetation that are dominated by introduced species such as Kentucky bluegrass, redtop (*Agrostis gigantea* Roth.), Canada bluegrass, white clover and 'weedy' species such as common dandelion (*Taraxacum officinale* Weber in Wiggers) and black medic. These plant communities are surrounded by mixed stands of Douglas fir, trembling aspen and lodgepole pine.

The ecological moisture regime of this community type is mesic and the ecological nutrient regime is mesotrophic. The soils of this community type have a sandy loam texture and a soil pH of 8 within the primary rooting layer. Litter and humus cover 90 percent of the surface substrate, dead wood covers 5 percent and rocks and exposed mineral soil comprise 5 percent. The soil is very compacted due to cattle grazing and access by recreational vehicles.

Cattle grazing of this community type is extensive but other ungulates such as mule deer make moderate use of these habitats as well. Access to thermal/hiding cover and water is generally good in this community type. Timber milkvetch is found in small amounts in this community type and may pose a problem for ungulates. A small number of black bear excavations are present.

Representative Site: Plot 14
Landscape Position: Terrace
Elevation: 990 m
Slope: 0%
Aspect: 0º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Poa pratensis	Kentucky Bluegrass	20
Agrostis gigantea	Redtop	10
Poa compressa	Canada Bluegrass	8
Calamagrostis canadensis	Bluejoint Reedgrass	3
Phleum pratense	Timothy	2
Festuca ovina	Hard Fescue	2
Hordeum jubatum	Foxtail Barley	1
Festuca rubra	Creeping Red Fescue	1
Juncus bufonius	Toad Rush	1
Forbs		
Taraxacum officinale	Common Dandelion	10
Medicago lupulina	Black Medic	6
Leucanthemum vulgare	Oxeye Daisy	5
Trifolium repens	White Clover	4
Achillea millefolium	Common Yarrow	2
Fragaria virginiana	Wild Strawberry	1

Gentianella amarella	Northern Gentian	1
Trifolium hybridum	Alsike Clover	1
Plantago major	Common Plantain	1

Shrubs

Symphoricarpos albus	Common Snowberry	3
Rosa gymnocarpa	Baldhip Rose	1

Production (kg/ha):

Grasses	928.4
Forbs	431.2
Shrubs	81.6
Total	1441.2

Stocking Rate: 928.4 kg/ha ÷ 450 kg/ha x 50% safe use = **1.03 AUMs per hectare.**

Photo 7. Community Type 7 Common Dandelion / Black Medic

Community Type 8 (N = 2) Orchardgrass - Canada Bluegrass (Photo 8)

This community type is widely distributed on reclaimed logging landings throughout the study area. The introduced species orchardgrass (*Dactylis glomerata* L.), Canada bluegrass and alsike clover (*Trifolium hybridum* L.) and the 'weedy' species Canada thistle (*Cirsium arvense* [L.] Scop.) and spreading groundsmoke (*Gayophytum diffusum* T. & G.) dominate this community type.

The ecological moisture regime of this community type is mesic and the ecological nutrient regime is mesotrophic. The soils of this type have a sandy loam texture and a soil pH of 8 in the primary rooting layer. The soils also have high coarse fragment contents consisting of gravel and subangular clasts. Litter and humus cover between 50 and 55 percent of the surface substrate while dead wood covers 5 to 10 percent. Most of the substrate surface in these habitats have between 30 and 40 percent exposed mineral soil.

This community type experiences heavy grazing by cows, elk and mule deer. Mule deer use this vegetation during spring, summer and fall. Timber milkvetch is found in small amounts in this community type. Bear scats are present in the representative plots.

Representative Site(s): Plots 5 and 9
Landscape Position: Terrace
Elevation: 1115 - 1170 m
Slope: 2 - 4%
Aspect: 50 - 90º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Dactylis glomerata	Orchardgrass	20
Poa compressa	Canada Bluegrass	3
Elymus glaucus	Blue Wild Rye	3
Agropyron spicatum	Bluebunch Wheatgrass	2
Poa pratensis	Kentucky Bluegrass	1
Forbs		
Trifolium hybridum	Alsike Clover	10
Cirsium arvense	Canada Thistle	5
Medicago sativa	Alfalfa	5
Gayophytum diffusum	Spreading Groundsmoke	5
Fragaria virginiana	Wild Strawberry	3
Epilobium angustifolium	Fireweed	2
Aster ciliolatus	Fringed Aster	2
Trifolium repens	White Clover	2
Epilobium ciliatum	Purple-Leaved Willowherb	1
Shrubs		
Rosa woodsii	Wood Rose	2

Spirea betulifolia	Birch-Leaved Spirea	1
Symphoricarpos albus	Common Snowberry	1
Betula occidentalis	Red Birch	+
Amelanchier alnifolia	Saskatoon	+

Production (kg/ha):

Grasses	1982.1
Forbs	606.4
Shrubs	322.6
Total	2911.1

Stocking Rate: 1982.1 kg/ha ÷ 450 kg/ha x 50% safe use = **2.20 AUMs per hectare.**

Photo 8. Community Type 8 Orchard Grass - Canada Bluegrass

Community Type 9 (N = 1) Water Sedge - Soft-Stemmed Bulrush (Photo 9)

This community type has a limited distribution in the study area and is confined to depressions on terrace benches. The vegetation is dominated by water sedge (*Carex aquatilis* Wahl.), soft-stemmed bulrush (*Scirpus lacustris* L.) and slimstem reedgrass (*Calamagrostis neglecta* [Ehrh.) G.M. & S.).

The ecological moisture regime of this type is hydric and the ecological nutrient regime is eutrophic. The soil of this community type is organic and has a pH of 8. Litter and humus cover 80 percent of the surface substrate.

Cattle and mule deer use this riparian community type extensively for water replenishment. The presence of marsh arrow-grass (*Triglochin palustre* L.) may be poisonous to livestock and non-domesticated ungulates.

Representative Site: Plot 21
Landscape Position: Depressions on Terrace Benches.
Elevation: 960 m
Slope: 0%
Aspect: 0º

Scientific Name	Common Name	Foliar Cover (%)
Grasses		
Carex aquatilis	Water Sedge	21
Scirpus lacustris	Soft-Stemmed Bulrush	5
Calamagrostis neglecta	Slim-stem Reedgrass	5
Scirpus microcarpus	Small-Flowered Bulrush	3
Forbs		
Mentha arvensis.	Field Mint	2
Potentilla anserina.	Silverweed	1
Polygonum amphibium	Water Smartweed	1
Shrubs		
Salix brachycarpa	Short-Fruited Willow	3
Salix barclayi	Barclay's Willow	1
Betula glandulosa	Bog Birch	1

Production (kg/ha):		
	Grasses	2577.2*
	Forbs	16.4*
	Shrubs	0.0*
	Total	2593.6* Estimate

Stocking Rate: 2577.2 kg/ha ÷ 450 kg/ha x 50% safe use = **2.86 AUMs per hectare.**

* Production cages are not present in this community type. Production values are based on utilization plots only.

Photo 9. Community Type 9 Water Sedge - Soft-stemmed Bulrush

3.2 Primary and Secondary Ranges

Four broad range types are present in the Steamboat Range Unit, e.g., native grasslands, wetlands, cutblocks and mature forests. The mature forest range type covers the largest area within the range unit, with cutblocks, native grasslands and wetlands present in descending order of magnitude.

The Red Rock pasture consists of six vegetation community types (CT1, CT2, CT4, CT5, CT7 and CT9) while the Tea Kettle pasture is comprised of eight community types (CT2, CT3, CT4, CT5, CT6, CT7, CT8 and CT9).

One community type (CT9) is described for the wetand range. The wetland range type is limited in size and distribution but is important as a source of water for domestic livestock and wild ungulates. The native grassland range also contains only one community type (CT1), while the remaining range types are characterized by vegetation associated with deciduous or coniferous dominated cutblocks or mature coniferous forests.

Herbage and forage production levels and carrying capacities for vegetation community types and primary and secondary ranges in the Red Rock and Tea Kettle pastures are listed Table 4. A list of individual map polygon sizes for the primary and secondary ranges of the range unit are presented in Appendix 3. Primary range for livestock in the Red Rock pasture is confined to native grasslands, clearcuts and roadsides. The primary range of the Tea Kettle pasture includes open meadows within mixed stands of trembling aspen and lodgepole pine, road verges and revegetated logging landings. Grassland areas are largely absent from the Tea Kettle pasture and only form a small component of the Red Rock pasture. Forested areas that have been clearcut also provide good primary range where water is readily accessible.

Most of the area in the two Steamboat Range Unit pastures are considered to be secondary range. Selectively cut forest areas provide good secondary range provided logging landings and roadsides have been reseeded with palatable agronomics. Observations provided by the tenure holder and Ministry of Forests personnel confirmed field observations which suggest that livestock tend to congregate on reseeded forest landings and roadside edges.

Table 4. Herbage and forage productivity (kg/ha) and carrying capacities for the Red Rock and Tea Kettle pastures of the Steamboat Range Unit.

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]
Red Rock	Primary	CT1	6.4	229.3	259.2	0	229.3	1467.5	1.7
		CT2	58.5	111.6	404.9	0	111.6	6528.6	7.0
		CT4	71.3	282.8	777.9	0	282.8	20163.6	22.1
		CT7	1.3	928.4	431.2	86.2	1014.6	1319.0	1.3
		Total	137.5	-	-	-	-	29478.7	32.1
	Secondary	CT5	188.8	565.8	823.8	0	565.8	106823.0	118.9
		CT9	2.4	2577.2	16.4	0	2577.2	6185.3	6.9
		Total	191.2	-	-	-	-	139700.5	125.8
Tea Kettle	Primary	CT3	1.4	1221.2	998.4	0	1221.2	1709.7	1.9
		CT2	18.9	111.6	404.9	0	111.6	2109.2	2.3
		CT4	443.4	282.8	777.9	0	282.8	125393.5	137.5
		CT7	5.1	928.4	431.2	86.2	1014.6	5174.5	5.8
		CT8	12.8	1982.1	606.4	0	1982.1	25370.8	28.2
		Total	481.6	-	-	-	-	159757.7	175.7
	Secondary	CT5	275.2	565.8	823.8	0	565.8	155708.2	173.4
		CT6	81.8	432.3	878.1	0	432.3	35362.0	39.3
		CT9	19.8	2577.2	16.4	0	2577.2	51028.6	56.6
		Total	376.8	-	-	-	-	242098.8	269.3

[1] Palatable forb is black medic.
[2] AUM = (Total forage x 0.5) / 450 kg.

3.3 Herbage and Forage Productivity

Forage production (kg/ha) for each community type is summarized in Table 5. All but CT1 (Western Mugwort / Awned Hair Cap Moss) and CT2 (Douglas Fir / Bluebunch Wheatgrass) community types have higher levels of forage production (e.g. >1000 kg/ha). The community types CT1 and CT2 have moderate levels of forage forage production (500 - 1000 kg / ha). A large proportion of the grass production consists of pinegrass.

Table 5. Forage production for community types in the Steamboat Range Unit.

Community Type	Forage Production (kg/ha)
CT 1. Western Mugwort/Awned Hair Cap Moss	491.0
CT 2. Douglas Fir / Bluebunch Wheatgrass	967.6
CT 3. Canada Bluegrass / Common Yarrow	2221.8
CT 4. Trembling Aspen / Northern Bedstraw	1309.4
CT 5. Birch-Leaved Spirea / Fireweed	1556.2
CT 6. Heart-Leaved Arnica - Twinflower	2308.0
CT 7. Common Dandelion / Black Medic	1441.2
CT 8. Orchard Grass - Canada Bluegrass	2911.1
CT 9. Water Sedge - Soft-Stemmed Bulrush	2593.6

Table 6. 1996 Monthly temperature and precipitation data and thirty year normals

		Apr	May	Jun	Jul	Aug	Sep
Precipitation							
30 yr. Normal	Snow	6.7 cm	0.6cm	trace	none	none	1.9cm
	Rainfall	22.0mm	43.0mm	50.5mm	31.6mm	34.4mm	31.1mm
	Total	27.8mm	43.6mm	50.5mm	31.6mm	34.4mm	32.6mm
1996	Total	34.4 mm	73.4mm	46.4mm	32.2mm	7.1mm	32.6mm
Temperature							
30 yr Normal	Mean	6.3	11.0	15.1	18.2	17.7	12.0
1996	Mean	6.9	8.5	14.5	19.2	18.5	10.9

Source: Atmospheric Environment Service, Cranbrook

Annual precipitation, particularly variation in rainfall, has an important influence on herbage production (Stoddart et al. 1975). Year-to-year comparisons are difficult because of variation in growing season weather conditions and the sensitivity of forage production to moisture availability. Graminoids, and to a lesser extent forbs, respond to increased rainfall between May and July by exhibiting higher growth rates. However, in mountainous areas, the effects of variations in annual rainfall are difficult to interpret because of the confounding effects of landscape heterogeneity, e.g., landscape position, catchment or seepage areas and the duration of moisture availability from snowmelt (Heady and Child 1994). In addition, species such as bluebunch wheatgrass (*Agropyron spicatum* [Pursh] Scribn. & Smith) can have considerable fall regrowth if temperature and moisture conditions are favorable (Ministry of Forests 1994).

The IDF or Interior Douglas-fir zone is the most important grazing range in British Columbia (Wikeem et al. 1993). In the southern interior, forage production tends to be highest at mid-elevations in the IDF zone. Grassland phases may have 475 - 2700 kilograms of air-dry forage per hectare (Ministry of Forests 1994). Within the Steamboat Range Unit, forage production ranges from 491.0 kilograms/hectare for CT1 (Western Mugwort / Awned Haircap Moss) to 2593.6 kilograms/hectare for CT9 (Water Sedge - Soft-Stemmed Bulrush). These two community types are at opposite ends of a moisture gradient.

During the growing season of 1996, the Steamboat Range Unit potentially received significantly higher precipitation during the month of May, as compared with 30 year normals, and significantly lower precipitation during August (Table 6). Mean monthly temperatures for 1996 are not significantly-different from the 30 year normals. Therefore, herbage production levels may have been higher than normal in mesic sites but lower than average on sub-xeric to xeric sites because of the unusually dry August. Unfortunately, it not known if the 1996 community type forage production values are representative of long-term pattern necessary for determination of carrying capacity. Nevertheless, the forage production information is useful, particularly, with respect to community types within the Steamboat Range Unit.

To assist in the management of this range unit, monitoring of herbage production should be undertaken. Establishment of 'reference areas' that are clipped using a systematic frequency will provide more reliable, long-term average production data.

3.4 Range Management Considerations

3.4.1 Limiting Landscape Features

Domestic livestock utilization of the Steamboat Range Unit is influenced strongly by topography, vegetation and available water. Lack of accessible stock water does not appear to be a constrain for either the Red Rock or Tea Kettle pastures although the low precipitaion levels during August, 1996 (Table 6) may have resulted in low levels of available water in the upper elevations of both pastures. Water availability is particularly good in the low to mid-elevations of the Tea Kettle pasture.

Thick forests and/or rugged topography are major deterrents to livestock grazing in the Red Rock pasture and to a lesser extent in the Tea Kettle pasture. Livestock grazing is primarily confined to road verges, logging landings and accessible clearcuts with suitable forage. Native grasslands are restricted to the Red Rock pasture. However, the native grasslands are on steep south-facing slopes (40%) which would not be able to withstand extensive domestic livestock grazing.

Significant portions, i.e., 2270.8 hectares, of the Steamboat Range Unit have forest canopy cover that is too extensive to produce adequate forage for domestic livestock grazing. As well, at least 57.3 hectares of the non-forested area is too rugged for cattle to traverse.

3.4.2 Patterns of Grazing Use

The current grazing rotation has 60 cows and 2 bulls grazing from May 15 - September 7 (115 days) on the Tea Kettle pasture and the same number of animals on September 8 - October 21 (44 days) on the Red Rock pasture. Each pasture is grazed once annually. Commencement of grazing and the length of the grazing period for each pasture has varied over the years since 1980 (Table 7). In 1996, the rotation order was reversed because of late range readiness so the grazing pattern was atypical (Tegart 1996).

All primary ranges within the Steamboat Range Unit are grazed by livestock to some extent. None of the native grasslands are unaffected by cattle grazing. However, the upper elevation of northern section of the Tea Kettle pasture is only very lightly grazed. The upper elevation of the Tea Kettle Pasture is rarely used (Tegart 1996).

The AUMs calculated in 1996 (Table 8) indicate that grazing patterns for the Red Rock and Tea Kettle pastures fall within the current capacities for each pasture. During 1996, heavy grazing was noted along road sides. The heavy grazing along the roadsides is symptomatic of the altered range rotation in 1996. Cleared landings (CT8) are preferred grazing areas since these areas have been revegetated with highly palatable agronomic species. Areas that have been clearcut or partially cut also provide good forage but salting is usually required to use these areas.

Based on field observations and discussions with the permit holder (Tegart 1996), the logging landings (CT8), road verges, open Douglas fir stands (CT2) and open trembling aspen stands (CT4) are the primary ranges in the study area. Partially or selectively cut and clearcut forested areas which are accessible to cattle are considered to be secondary range for domestic livestock. Heavily forested areas, and to a lesser extent topography, are the major limiting factors for grazing in the Red Rock and Tea Kettle pastures.

Table 7. AUMs (i.e., total AUMs - 50% for safe use), for pastures in the Steamboat Range Unit from 1980 - 1985. Numbers in parentheses indicate the grazing rotation sequence for each year.

Pasture	Year					
	1985	1984	1983	1982	1981	1980
South	97 (1)	97 (1)	97 (1)	53 (1)	53 (1)	53 (1)
North	97 (2)	97 (2)	97 (2)	97 (2)	97 (2)	97 (2)
Cow/Calf	25	25	25	21	21	21
Bulls	1	1	1	1	1	1
Total	194	194	194	150	150	150
Private Land Deduction	78	78	78	39	39	39
Net Annual Use	116	116	116	111	111	111

Table 8. AUMs (i.e., total AUMs - 50% for safe use), for pastures in the Steamboat Range Unit from 1986 - 1996. Numbers in parentheses indicate the grazing rotation sequence for each year. The first column indicates the AUMs generated for primary range during the 1996 range inventory.

Pasture	Year										
	96	**95**	**94**	**93**	**92**	**91**	**90**	**89**	**88**	**87**	**86**
Red Rock	63 (1)	63 (1)	-	-	-	-	124 (1,3)	124 (1,3)	104 (1,3)	80 (1)	80 (1)
Tea Kettle	63 (2)	63 (2)	-	-	-	-	195 (2)	195 (2)	162 (2)	130 (2)	130 (2)
Cow/calf	63	60	-	-	-	-	60	60	50	38	38
Bulls	2	2	-	-	-	-	2	2	2	2	2
Total	126	126	-	-	-	-	319	319	266	210	210
Private Land Deduction	-	-	-	-	-	-	-	-	-	-	-
Net Annual Use	126	126	-	-	-	-	319	319	319	319	319

3.4.3 Ungrazed Sites for Potential Monitoring

All primary ranges within the Steamboat Range Unit appear to have been grazed by livestock to some extent. None of the native grasslands would be considered to be unaffected by cattle grazing. However, the upper elevation of northern section of the Tea Kettle pasture is grazed very lightly. The upper elevation cutblocks of the Tea Kettle pasture may be suitable reference sites for monitoring livestock grazing.

3.4.4 Damaged Watering Areas or Trails

Livestock can have detrimental effects upon riparian ecosystems (Kauffman and Krueger 1984). Unlike wild ungulates, cattle spend a considerable amount of time in riparian habitats (Fleischner 1994). Only the stream between transect 12 and the corral showed signs of damage, but erosion is not extensive. However, the area near transect 12 should be monitored. Tegart (1996) indicated that the heavy use in this area was abnormal. However, soil compaction of the magnitude observed in the area surrounding transect 12 does not appear to be the result of activity restricted to 1996. Access to this area should be restricted to periods when the soil is dry so that livestock hooves do not damage or cause compaction (British Columbia Ministry of Environment 1995a).

Trails throughout the Steamboat Range Unit are in relatively good condition.

3.4.5 Interaction of Alternate Users with Livestock Management

Steamboat Mountain and the surrounding area contain populations of Rocky Mountain elk, mule deer and white-tailed deer (*Odocoileus virginiana* Zimmermann) which provide good opportunites for recreational hunters in the Steamboat Range Unit. In general, the tenure holder has not had any conflicts with hunters, although there have been problems with poachers. Vehicular access by hunters has not damaged the area appreciably. Logging truck drivers are very careful of the domestic livestock, so there has not been any mortality due to truck collisons.

3.4.6 Current Management Practices

Currently, rotation of cattle between pastures with horses and application of salt are the main management practices applied by the tenure holder (Tegart 1996).

The application of salt is an important management practice (Heady and Child 1994). Salting is used as an incentive to encourage livestock movement into under-utilized secondary grazing areas and away from highly used primary grazing areas. However, if areas of completely different vegetation types are salted, livestock will typically walk into the area, use the salt and then return to

primary ranges without actually grazing the secondary range. To prevent localized overuse by livestock, salt locations are moved each year.

Conventional salting practices are not used in the Steamboat Range Unit. In general, the tenure holder carries salt in plastic dishes which is placed where the cattle are found. The salt is then removed to ensure the animals do not return to the same location (Tegart 1996). As a general practice, salt is also located away from riparian areas which are easily disturbed and sensitive to livestock use. This practice is compatible with the recommendations of the Range Management Guidebook (British Columbia Ministry of Environment 1995a).

3.4.7 Access Problems

In general, access to forage and water is good throughout the Steamboat Range Unit. Timber harvesting in both the Tea Kettle and Red Rock pastures has created a network of roads and trails, providing good access to most of these pastures. None of the clear cuts had coarse woody debris which would limit domestic livestock access.

3.4.8 Wildlife Use

Indirect wildlife habitat utilization signs, e.g., excrement, feeding signs, territorial markings, homesites, sounds, tracks and excavations, were recorded at each transects and along transect access traverses, during the Steamboat Range Unit inventory. The following information is based upon these indirect study-based observations and the anecdotal observations of Tegart (1996).

Populations of wild game ungulates, e.g., Rocky Mountain elk, mule deer, white-tailed deer and carnivores e.g., coyotes (*Canis latrans* Say), cougar and black bear (*Ursus americanus* Pallas), are present within the range unit. Tegart (1996) suggests that gray wolves (*Canis lupus* Linnaeus) are present within the range unit but this assertion is not supported by any field-based evidence.

Signs of rodents, e.g., red squirrel (*Tamiasciurus hudsonicus* Erxleben), and columbian ground squirrels and lagomorphs, e.g., snowshoe hares, are common throughout the study area.

As well, avifauna such as dark-eyed juncos (*Junco hyemalis* Linnaeus), ruffed grouse, pileated woodpeckers (*Dryocopus pileatus* Linneaus), downey woodpeckers (*Picoides pubescens* Linnaeus), crows (*Corvus brachyrhynchos* Brehm), sharp-shinned hawks (*Accipiter striatus* Vieillot), red-tailed hawks (*Buteo jamaicensis* Gmelin) and american kestrels (*Falco sparverius* Linnaeus) are present.

White-tailed deer use the lower elevations of the Steamboat Range Unit and overwinter along the Columbia River and adjacent lowlands. In the summer,

white-tailed deer are scattered throughout the lower elevations of Steamboat Mountain.

Elk do not reside within the Steamboat Range Unit but they do use the range unit to move back and forth between the Columbia River slough and the Horse Thief Creek and Forster Creek drainages (Tegart 1996). In general, the elk move back through the range prior to rutting season in late September. The elk use the open ridges below the Red Rock road following the rut.

Limited evidence of cougar presence was recorded in the wildlife observations of transect 18. Direct evidence of ungulate predation by cougars and wolves was not, or has not, been observed. However, Tegart (1996) suggests that the number of wolves is increasing and that their presence is displacing the elk population.

The degree of forage competition between wildlife (e.g. deer and elk) and livestock on primary range is not part of the scope of the present study. Maintaining levels of cattle grazing on primary range and leaving forage on secondary range for elk will reduce forage competition, but it is unlikely to eliminate it completely. Moose (*Alces alces* Linnaeus) and deer do not usually conflict with livestock because they tend to use different types of forage and different habitats (Heady and Child 1994). The wild ungulates appear to move into areas grazed by the domestic livestock in the fall. Tegart (1996) suggests that the deer and elk forage in these areas because of the flush of vegetative growth that occurs after the cattle have moved.

Management practices such as salting away from water should be continued to disperse cattle grazing pressure. Limiting stocking rates to carrying capacity provided by primary range will also ensure moderate levels of livestock use and will minimize wildlife competition with cattle.

4.0 RECOMMENDATIONS

Several range management recommendations are proposed as a result of the 1996 Steamboat Range Unit inventory.

(1) Presently, salting is the preferred management technique to attract livestock from primary to secondary ranges, and to obtain a better distribution of livestock use on these ranges. Salt locations are moved each year to prevent localized overuse. All salting should occur on secondary or unutilized range. These salting practices should be continued to effectively use and maintain current levels of rangeland forage.

(2) The number of AUMs in the Steamboat Range Unit has varied between 194 and 319 during the last 16 years. The current AUMs for the Tea Kettle pasture can be maintained or possibly increased, but the AUMs for the Red Rock should be decreased due to the lower aerial extent of primary range.

(3) In the past, the tenure holder has completed range improvements such as the installation of cattle guards and new fencing and the re-positioning of old fencing. However, cattle from other tenure holders in the area have been getting into the Steamboat Range Unit from the west side of the mountain (Tegart 1996). If this problem increases in magnitude, fencing might be considered for the area along the top of Steamboat Mountain. Hopefully, fencing along the ridge would prevent 'foreign' cattle from moving into the Steamboat Range Unit. This is important because the top part of the Tea Kettle pasture is under-utilized currently.

(4) Native grasslands are limited in aerial extent within the Steamboat Range Unit. These areas are important habitat for mule deer and elk, and because of the silt-loam soils and slopes, are sensitive to disturbance. Domestic livestock utilization of this community type should therefore be monitored closely to ensure these areas are not overgrazed.

(5) The upper elevation of the Tea Kettle pasture is under-utilized. The vegetation along the access road to this area is dominated by fireweed (*Epilobium angustifolium* L.). These roadsides should be revegetated with palatable and persistent, but not aggressive, agronomics. Less palatable agronomics should be used where slope stabilization or soil erosion is a concern. In the future, all logging landings should be revegetated with palatable agronomics. The high standing crop production of these species and the close proximity of water in these areas would increase the aerial extent of primary range within the Steamboat Range Unit. Several logging landings had compacted soils. All landings should be ripped prior to revegetation.

(6) The extensive use of the Steamboat Range Unit by black bears (berry crop and ant logs and stumps) and increasing use by wolves (Tegart 1996) indicates

that carnivore populations in the area should, at the very least, be monitored anecdotally by either the tenure holder or the Ministry of Forests. The upper elevations of the range unit, which have a greater percent cover of productive berry-producing species, should be monitored in particular.

(7) Several of the community types have small percentage cover of known toxic plants, e.g., timber (columbia) milkvetch, marsh arrow grass and mountain death-camas. The populations of these species should be monitored to determine if they are increasing or decreasing in size. As well, the effects of these species on domestic livestock should be monitored.

(8) Noxious weeds such as common hound's tongue which was found in transect 12 and Canada thistle which was found in transects 5, 9, 14, 16 and 22, should be eradicated. The Tea Kettle pasture roads and logging landings should receive special attention.

(9) An on-going monitoring program of range productivity and carrying capacity should be maintained with re-assessment conducted on a regular basis.

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APPENDIX 1. Steamboat Range Unit Inventory Transect GPS Location

STEAMBOAT RANGE UNIT INVENTORY TRANSECT GPS LOCATION				
RANGE UNIT	**TRANSECT #**	**NORTHING**	**EASTING**	**ORIENTATION °**
Steamboat	1	5,616,665	556,270	10
Steamboat	2	5,616,484	555,691	320
Steamboat	3	5,617,945	554,583	140
Steamboat	4	5,513,189	561,347	40
Steamboat	5	5,622,752	552,467	140
Steamboat	6	5,621,043	552,647	340
Steamboat	7	5,619,100	553,692	35
Steamboat	8	5,620,872	553,468	150
Steamboat	9	5,623,894	551,561	30
Steamboat	10	5,618,034	556,770	330
Steamboat	11	5,619,481	556,482	85
Steamboat	12	5,619,345	556,683	50
Steamboat	13	5,620,206	552,948	150
Steamboat	14	5,620,106	556,082	150
Steamboat	15	5,623,460	550,480	140
Steamboat	16	5,623,456	550,665	160
Steamboat	17	5,620,345	553,328	150
Steamboat	18*	5,614,089	560,822	120
Steamboat	19	5,613,156	561,097	80
Steamboat	20	5,613,937	561,000	280
Steamboat	21	5,624,983	552,671	80
Steamboat	22	5,623,437	553,422	140

* GPS coordinates may be in error due to poor satellite coverage at this transect location.

Appendix 2 Species List for Steamboat Range Unit.

Scientific Name	Common Name	Rarity
1. Non-Vascular Plants		
Mosses		
Brachythecium albicans Hedw.	Common Lawn Moss	-
Brachythecium salebrosum (Web. & Mohr.) B.S.G.	Golden Ragged Moss	-
Ceratodon purpureus (Hedw.) Brid.	Fire Moss	-
Dicranum fuscescens Turn.	Curly Heron's-Bill Moss	-
Dicranum polysetum Sw.	Wavy-Leaved Moss	-
Drepanocladus uncinatus (Hedw.) Warnst.	Sickle Moss	-
Hylocomium splendens (Hedw.) B.S.G.	Step Moss	-
Pleurozium schreberi (Brid.) Mitt.	Red-Stemmed Feather-moss	-
Pohlia cruda (Hedw.) Lindb.	Common Pohlia	-
Pohlia nutans (Hedw.) Lindb.	Nodding Pohlia	-
Polytrichum commune Hedw.	Common Hair-Cap Moss	-
Polytrichum piliferum Hedw.	Awned Hair-Cap Moss	-
Polytrichum juniperinum Hedw.	Juniper Hair-Cap Moss	-
Ptilium crista-castrensis (Hedw.) De. Not.	Knight's Plume Moss	-
Tortula ruralis (Hedw.) Gaertn., Meyer & Scherb.	Sidewalk Moss	-
Liverworts		
Barbilophozia lycopodioides (Wallr.) Loeske	Common Leafy Liverwort	-
Marchantia polymorpha L.	Green-Tongue Liverwort	-
Lichens		
Cladonia cariosa (Ach.) Spreng.	Torn Club Lichen	-
Cladonia cornuta (L.) Hoffm.	Pioneer Lichen	-
Cladonia fimbriata (L.) Fr.	Green Trumpet Lichen	-
Cladonia gracilis (L.) Willd.	Black-Foot Cladonia	-
Cladonia pyxidata (L.) Hoffm.	Brown Pixie-cup	-
Diploschistes muscorum (Schreb.)	Cow Pie	-
Peltigera aphthosa (L.) Willd.	Studded Leather Lichen	-
Peltigera canina (L.) Willd.	Dog Lichen	-
Stereocaulum tomentosum Fr.	Wooly Coral	-
2. Vascular Plants		
Lycododiaceae (Clubmoss Family)		
Lycopodium complanatum L.	Ground-Cedar	-
Selaginellaceae (Selaginella)		
Selaginella densa Rydb.	Compact Selaginella	-
Equisetaceae (Horsetail Family)		
Equisetum arvense L.	Common Horsetail	-
Polypodiaceae (Common Fern Family)		
Adiantum pedatum L.	Maidenhair Fern	-
Cupressaceae (Cypress Family)		

Juniperus communis L.	Common Juniper	-
Juniperus scopulorum Sarg.	Rocky Mountain Juniper	-
Pinaceae (Pine Family)		
Abies lasiocarpa (Hook.) Nutt.	Subalpine Fir	-
Picea engelmannii Parry	Engelmann Spruce	-
Pinus contorta Dougl. var. *latifolia* Engelm.	Lodgepole Pine	-
Pseudotsuga menziesii var. *glauca* (Beissen.) Franco	Douglas Fir	-
Salicaceae (Willow Family)		
Populus balsamifera ssp. *balsamifera* L.	Balsam Poplar	-
Populus tremuloides Michx.	Trembling Aspen	-
Salix barclayi Anderrs.	Barclay's Willow	-
Salix bebbiana Sarg.	Bebb's Willow	-
Salic brachycarpa Nutt.	Short-Fruited Willow	-
Salix scouleriana Barratt	Scouler's Willow	-
Betulaceae (Birch Family)		
Alnus crispa ssp. *crispa* (Ait.) Pursh	Green Alder	-
Betula glandulosa Michx.	Bog or Scrub Birch	-
Betula occidentalis Hook.	Red Birch	-
Santalaceae (Sandalwood Family)		
Commadra umbellata (L.) Nutt.	Pale Commandra	-
		-
Caryophyllaceae (Pink Family)		
Arenaria serpyllifolia L.	Thyme-Leaved Sandwort	-
Cerastium arvense L.	Field Chickweed	-
Silene menziesii Hook.	Menzie's Silene	-
Chenopodiaceae (Goosefoot Family)		
Chenopodium capitatum (L.) Asch.	Strawberry Blite	-
Chenopodium rubrum (L.) Aellen	Red Goosefoot	-
Ranunculaceae (Buttercup Family)		
Actaea rubra (Ait.) Willd.	Baneberry	-
Aquilegia flavescens Wats.	Yellow Columbine	-
Anemone multifida Poir.	Cut-Leaved Anemone	-
Clematis occidentalis (Nutt.) T & G.	Columbia Clematis	-
Thalictrum occidentale A. Gray	Western Meadow Rue	-
Berberidaceae (Oregon Grape Family)		
Mahonia aquifolium Pursh	Tall Oregon Grape	-
Brassicaceae [Cruciferae] (Mustard Family)		
Arabis glabra (L.) Bernh.	Towermustard	-
Arabis holboellii Hornem.	Holboell's Rockcress	-
Lesquerella douglasii Wats.	Columbia Bladderpod	-
Sisymbrium altissimum L.	Tumblemustard	-
Saxifragaceae (Saxifrage Family)		
Heuchera cylindrica Dougl.	Round-leaf Alumroot	-
Mitella nuda L.	Common Mitrewort	-
Grossulariaceae (Currant Family)		

Ribes lacustre (Pers.) Poir.	Swamp Currant	-
Ribes oxycanthoides ssp. *oxyacanthoides* L.	Northern Gooseberry	-
Rosaceae (Rose Family)		
Cratageous douglasii Lindl.	Black Hawthorn	-
Fragaria virginiana Duchesne	Wild Strawberry	-
Potentilla anserina L.	Silverweed	-
Rosa acicularis Lindl.	Prickly Rose	-
Rosa gymnocarpa Nutt.	Baldhip Rose	-
Rosa woodsii Lindl.	Wood's Rose	-
Rubus idaeus L.	American Red Raspberry	-
Rubus parviflorus Nutt.	Western Thimbleberry	-
Rubus pubescens Raf.	Dwarf Red Blackberry	-
Spirea betulifolia Pall.	Birch-Leaved Spirea	-
Fabaceae [Leguminosae] (Pea Family)		
Astragalus agrestis Dougl.	Purple Milkvetch	-
Astragalus miser Dougl.	Timber Milkvetch	-
Astragalus tenellus Pursh	Pulse Milkvetch	-
Hedysarum sulphurescens Rydb.	Sulphur-flowered Hedysarum	-
Lathyrus ochroleucus Hook.	Cream-flowered Peavine	-
Medicago lupulina L.	Black Medic	-
Medicago sativa L.	Alfalfa	-
Oxytropis campestris (L.) DC.	Field Crazyweed	-
Trifolium hybridum L.	Alsike Clover	-
Trifolium repens L.	White Clover	-
Vicia americana Muhl.	American Vetch	-
Linaceae (Flax Family)		
Linum perenne var. *lewisii* (Pursh) Eat. & Wright	Wild Blue Flax	-
Aceraceae (Maple Family)		
Acer glabrum Torr.	Douglas' Maple	-
Violaceae (Violet Family)		
Viola adunca Sm.	Early Blue Violet	-
Viola orbiculata Geyer ex W.J. Hooker	Round-Leaved Violet	-
Eleagnaceae (Oleaster Family)		
Shepherdia canadensis (L.) Nutt.	Canada Buffalo-Berry	-
Onagraceae (Evening-Primrose Family).		
Epilobium angustifolium L.	Firewee d	-
Epilobium ciliatum ssp. *ciliatum* Raf.	Purple-Leaved Willow-Herb	-
Epilobium minutum Lindl. ex Hook.	Small-Flowered Willow-Herb	-
Gayophytum diffusum T. & G.	Spreading Groundsmoke	-
Araliaceae (Gensing Family)		
Aralia nudicaulis L.	Wild Sarsaparilla	-
Apiacea [Umbelliferae] (Parsley Family)		
Lomatium triternatum (Pursh) Coult. & Rose	Narrow-Leaved Desert Parsley	-

Cornaceae (Dogwood Family)		
Cornus canadensis L.	Bunchberry	-
Cornus stolonifera Michx.	Red-osier Dogwood	-
Ericaceae (Heath Family)		
Arctostaphylos uva ursi Sprengl	Bearberry	-
Chimaphila umbellata (L.) Bart.	Prince's Pine	-
Menziesia ferrugineae Smith	Rusty Pacific Menziesia	-
Orthilia secunda (L.)	One-Sided Wintergreen	-
Pyrola asarifolia Michx.	Common Pink Wintergreen	-
Vaccinium caespitosum Michx.	Dwarf Huckleberry	-
Vaccinium membranaceum Dougl.	Black Hucklebery	-
Vaccinium scoparium Leiberg	Grouseberry	-
Gentianaceae (Gentian Family)		
Gentianella amarella L.	Northern Gentian	-
Apocynaceae (Dogbane Family)		
Apocynum androsaemifolium L.	Spreading Dogbane	-
Boraginaceae (Borage Family)		
Cynoglossum officinale L.	Common Hound's Tongue	-
Lithospermum ruderale Dougl.	Lemonweed	-
Labiatae (Mint Family)		
Mentha arvensis L.	Field Mint	-
Scrophulariaceae (Figwort Family)		
Castilleja miniata Dougl. ex Hook.	Common Red Paintbrush	-
Collinsia parviflora Dougl *ex* Lindl.	Small-Flowered Blue-Eyed Mary	
Melampyrum lineare Desr.	Cow-Wheat	-
Pedicularis bracteosa Bentham in Hook.	Bracted Lousewort	-
Pedicularis racemosa Dougl.	Sickletop Lousewort	-
Penstemon confertus Dougl.	Yellow Beard-tongue	-
Penstemon procerus Dougl.	Slender Blue Penstemon	-
Verbascum thapsus L.	Flannel Mullein	-
Plantaginaceae (Plantain Family)		
Plantago major L.	Common Plantain	-
Rubiaceae (Madder Family)		
Galium boreale L.	Northern Bedstraw	-
Galium triflorum Michx.	Sweet-Scented Bedstraw	-
Caprifoliaceae (Honeysuckle Family)		
Linnaea borealis L.	Northern Twinflower	-
Lonicera ciliosa (Pursh) DC.	Orange Honeysuckle	-
Lonicera involucrata (Rich.) Banks	Twinberry Honeysuckle	-
Lonicera utahensis Wats.	Utah Honeysuckle	-
Symphoricarpos albus (L.) Blake	Common Snowberry	-
Valerianaceae (Valerian Family)		
Valeriana dioica L.	Northern Marsh Valerian	-
Campanulaceae (Harebell Family)		

Campanula rotundifolia L.	Common Harebell	-
Asteraceae (Aster Family)		
Achillea millefolium L.	Common Yarrow	-
Agoseris glauca (Pursh) Raf.	Pale Agoseris	-
Antennaria microphylla Rydb.	Rosy Pussy-Toes	-
Antennaria neglecta Greene	Field Pussy-Toes	-
Antennaria racemosa Hook.	Raceme Pussy-Toes	-
Arnica cordifolia Hook.	Heart-Leaved Arnica	-
Arnica latifolia Bong.	Mountain Arnica	-
Artemesia frigida Willd.	Pasture Sage	-
Artemesia ludoviciana var. *ludoviciana* Nutt.	Western Mugwort	-
Aster ciliolatus Lindl.	Fringed Aster	-
Aster conspicuus Lindl. in Hook	Showy Aster	-
Aster engelmannii (Eat.) Gray	Engelmann's Aster	-
Aster foliaceus Lindl. in DC.	Leafy Aster	-
Cirsium arvense (L.) Scop.	Canada Thistle	-
Cirsium vulgare (Savi) Tenore	Bull Thistle	-
Crepis atrabarba ssp. *originalis* Heller	Slender Hawksbeard	-
Erigeron compositus Pursh var. *glabratus* Macoun	Cut-Leaved Fleabane	-
Erigeron corymbosus Nutt.	Long-Leaved Fleabane	-
Erigeron linearis (Hook.) Piper	Line -Leaved Fleabane	-
Erigeron pumilus Nutt.	Shaggy Fleabane	-
Filago arvensis L.	Field Filago	-
Gaillardia aristata Pursh.	Gaillardia	-
Heterotheca villosa (Pursh) Nutt.	Hairy Golden Aster	-
Hieracium umbellatum L.	Narrow-Leaved Hawkweed	-
Leucanthemum vulgare L.	Oxeye Daisy	-
Matricaria matricarioides (Less.) Porter	Pineapple Weed	-
Senecio canus Hook.	Wooly Groundsel	-
Senecio pauperculus Michx.	Balsam Groundsel	-
Senecio pseudaureus Rydb.	Streambank Butterweed	-
Solidago canadensis L.	Canada Goldenrod	-
Solidago spathulata DC.	Spike-Like Goldenrod	-
Sonchus arvensis L.	Perennial Sow-Thistle	-
Taraxacum officinale Weber in Wiggers	Common Dandelion	-
Juncaginaceae (Arrow-Grass Family)		
Triglochin palustre L.	Marsh Arrow-Grass	-
Juncaeae (Rush Family)		
Juncus bufonius L.	Toad Rush	-
Cyperaceae (Sedge Family)		
Carex aquatilis Wahl.	Water Sedge	-
Carex aurea Nutt.	Golden Sedge	-
Carex concinnia R.Br.	Low Northern Sedge	-
Carex concinnoides Mack	Northwest Sedge	-
Carex lanuginosa Michx.	Wooly Sedge	-
Carex rossii Boot.	Ross's Sedge	
Carex rostrata Stokes ex. With.	Beaked Sedge	-
Kobresia simpliciuscula (Wahl.) Mack.	Simple Kobresia	-
Scirpus lacustris L.	Soft-Stemmed Bulrush	-
Scirpus microcarpus Presl	Small-Flowered Bulrush	-
Poaceae (Grass family)		

Agropyron repens (L.) Beauv.	Quackgrass	-
Agropyron spicatum (Pursh) Scribn. & Smith	Bluebunch Wheatgrass	-
Agrostis gigantea Roth	Redtop	-
Agrostis scabra Willd.	Rough Hair-Grass	-
Bromus anomalus Rupr.	Nodding Brome	
Bromus inermis ssp. *inermis* Leys.	Smooth Brome	-
Calamagrostis canadensis (Michx.) Beauv.	Bluejoint Reedgrass	
Calamagrostis neglecta (Ehrh.) G.M. & S.	Slimstem Reedgrass	-
Calamagrostis rubescens Buckl.	Pine Grass	-
Dactylis glomerata L.	Orchard-Grass	-
Elymus glaucus Buckl.	Blue Wild Rye	-
Festuca idahoensis Elmer	Idaho Fescue	-
Festuca ovina L.	Sheep's Fescue	-
Festuca rubra L.	Red Fescue	-
Glyceria striata (Lam.) Hitchc.	Fowl Mannagrass	-
Hordeum jubatum L.	Foxtail Barley	-
Koeleria cristata Pers.	Junegrass	-
Oryzopsis asperifolia Michx.	Rough-Leaved Ricegrass	-
Phleum pratense L.	Common Timothy	-
Poa compressa L.	Canada Bluegrass	-
Poa glaucifolia Scribn. & Will.	Pale-Leaved Bluegrass	-
Poa palustris L.	Fowl Bluegrass	-
Poa pratensis L.	Kentucky Bluegrass	-
Stipa comata Trin. & Rupr.	Needle-and-Thread Grass	-
Stipa columbiana Macoun.	Columbia Needlegrass	-
Stipa curtiseta (A.S. Hitchc.) Barkw.	Short-Awned Porcupine Grass	
Stipa occidentalis Thurb.	Western Needlegrass	-
Stipa richardsonii Link	Richardson's Needlegrass	-
Trisetum spicatum (L.) Richt.	Spike Trisetum	-

Liliaceae (Lily Family)

Allium cernuum Roth.	Nodding Onion	-
Calochortus macrocarpus Dougl.	Sagebrush Mariposa	-
Disporum hookeri (Torr.) Nicholson	Hooker's Fairy-Bell	-
Erythronium grandiflorum Pursh	Yellow Glacier Lily	-
Stenathium occidentale Gray.	Mountainbells	-
Zigadenus elegans Pursh	Mountain Death-Camas	-

Orchidaceae (Orchid Family)

Goodyera oblongifolia Raf.	Western Rattlesnake-Plantain	-
Listeria cordata (L.) R.Br.	Heart-Leaved Twayblade	-
Platanthera dilatata (Pursh) Hook.	White Bog Orchid	-

APPENDIX 3. Map polygons of primary and secondary ranges in the Steamboat Range Unit.

Polygon Number	Pasture	Range Type	Community Type	Area (ha)
53	Tea Kettle	2º	CT5	3.6
54	Tea Kettle	2º	CT5	7.2
55	Tea Kettle	2º	CT5	12.7
56	Tea Kettle	2º	CT5	86.5
57	Tea Kettle	2º	CT5	22.4
58	Tea Kettle	2º	CT5	12.0
59	Tea Kettle	2º	CT5	130.8
153	Red Rock	2º	CT5	122.7
60	Red Rock	2º	CT5	66.1
61	Tea Kettle	2º	CT4	10.0
62	Tea Kettle	2º	CT4	20.7
63	Tea Kettle	2º	CT4	35.4
64	Tea Kettle	2º	CT4	36.5
65	Tea Kettle	2º	CT4	2.6
66	Tea Kettle	2º	CT4	36.1
67	Tea Kettle	2º	CT4	5.5
68	Tea Kettle	2º	CT4	22.3
69	Tea Kettle	2º	CT4	43.5
70	Tea Kettle	2º	CT4	57.0
71	Tea Kettle	2º	CT4	15.1
72	Tea Kettle	2º	CT4	3.5
73	Tea Kettle	2º	CT4	46.7
74	Tea Kettle	2º	CT4	3.3
75	Tea Kettle	2º	CT4	31.1
76	Tea Kettle	2º	CT4	56.3
77	Red Rock	2º	CT4	7.1
78	Red Rock	2º	CT4	14.8
154	Tea Kettle	2º	CT4	5.6
79	Red Rock	2º	CT4	1.4
155	Tea Kettle	2º	CT4	2.9
80	Red Rock	2º	CT4	2.2
81	Red Rock	2º	CT4	12.2
82	Red Rock	2º	CT4	31.8
83	Red Rock	2º	CT4	5.5
84	Red Rock	2º	CT4	3.4
85	Tea Kettle	2º	CT4	2.2
86	Tea Kettle	2º	CT6	38.9
87	Tea Kettle	2º	CT6	6.3
88	Tea Kettle	2º	CT6	36.6

95	Tea Kettle	2º	CT9	4.0
96	Tea Kettle	2º	CT9	4.6
97	Tea Kettle	2º	CT9	1.3
98	Tea Kettle	2º	CT9	2.3
99	Tea Kettle	2º	CT9	1.1
100	Tea Kettle	2º	CT9	2.3
101	Tea Kettle	2º	CT9	1.9
102	Tea Kettle	2º	CT9	2.3
103	Red Rock	2º	CT9	1.6
104	Red Rock	2º	CT9	0.8
105	Tea Kettle	1º	CT7	1.1
106	Tea Kettle	1º	CT7	1.3
107	Tea Kettle	1º	CT7	1.3
108	Tea Kettle	1º	CT7	1.4
109	Red Rock	1º	CT7	1.3
110	Tea Kettle	2º	CT2	2.7
111	Tea Kettle	2º	CT2	12.5
112	Tea Kettle	2º	CT2	3.7
113	Red Rock	2º	CT2	2.0
114	Red Rock	2º	CT2	3.3
115	Red Rock	2º	CT2	1.8
116	Red Rock	2º	CT2	1.6
117	Red Rock	2º	CT2	1.6
118	Red Rock	2º	CT2	2.5
119	Red Rock	2º	CT2	16.1
120	Red Rock	2º	CT2	2.2
121	Red Rock	2º	CT2	2.1
122	Red Rock	2º	CT2	3.9
123	Red Rock	2º	CT2	3.5
124	Red Rock	2º	CT2	9.3
125	Red Rock	2º	CT2	4.6
126	Red Rock	2º	CT2	4.0
127	Tea Kettle	1º	CT8	0.4
128	Tea Kettle	1º	CT8	0.8
129	Tea Kettle	1º	CT8	0.5
130	Tea Kettle	1º	CT8	0.4
131	Tea Kettle	1º	CT8	1.0
132	Tea Kettle	1º	CT8	1.4
133	Tea Kettle	1º	CT8	0.9
134	Tea Kettle	1º	CT8	1.1
135	Tea Kettle	1º	CT8	0.5
136	Tea Kettle	1º	CT8	0.6
137	Tea Kettle	1º	CT8	1.3
138	Tea Kettle	1º	CT8	0.5
139	Tea Kettle	1º	CT8	0.4
140	Tea Kettle	1º	CT8	0.5

141	Tea Kettle	1º	CT8	0.2
142	Tea Kettle	1º	CT8	0.2
143	Tea Kettle	1º	CT8	0.5
144	Tea Kettle	1º	CT8	0.2
145	Tea Kettle	1º	CT8	1.1
146	Tea Kettle	1º	CT8	0.3
147	Red Rock	1º	CT1	1.0
148	Red Rock	1º	CT1	1.5
149	Red Rock	1º	CT1	1.5
150	Red Rock	1º	CT1	1.1
151	Red Rock	1º	CT1	1.3
152	Tea Kettle	1º	CT3	1.4

APPENDIX 4. Wildlife observations for the 1996 Steamboat Range Unit inventory.