CARIBOO -CHILCOTIN GRASSLANDS STRATEGY

Forest Encroachment onto Grasslands and Establishment of a Grassland Benchmark Area

Prepared for
Cariboo-Mid Coast Interagency Management Committee

Prepared by
Cariboo-Chilcotin
Grasslands Strategy Working Group
January, 2001
Williams Lake, B.C.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Cariboo-Chilcotin Grassland Strategy Working Group was directed by the Interagency Management Committee (IAMC) to prepare a regional grassland strategy, to serve as a strategic framework for grassland conservation in the Cariboo-Chilcotin. This interim report presents initial progress towards this strategy. It focuses on establishing and maintaining a benchmark grassland area and controlling forest encroachment onto this area.

Specific objectives of this report are to:

- To recommend a grassland benchmark area, to be managed as grassland.
- Recommend management objectives for grassland benchmark area.
- To evaluate the implications of the benchmark on forage production and AUM allocation, biodiversity and timber.

These objectives are to contribute to the sustainability of grassland habitat and species while maintaining grazing targets as identified by the CCLUP.

The need to address in-growth, or increased tree densities in forest stands adjacent to the benchmark area, is clearly acknowledged in this report but specific guidelines have not been completed. These guidelines, along with other components of a grassland strategy, will be contained in a subsequent report.

Forest encroachment has significantly reduced the area of open grasslands and open range within the Cariboo-Chilcotin over the last 100 years. It is estimated that the area of open grasslands (<15% tree cover) has been reduced by more than 30% since 1962 in some areas, such as Becher's Prairie, and converted to forest. Across the region, it is estimated that more than 20,000 ha, or 11% of open grasslands have been encroached by forest since the early 1960's. Probably a much larger area of open grassland was encroached by forest between the late 1800's and 1960. The virtual stopping of grassland wildfires following European settlement has been a principal cause of forest encroachment.

The loss of grassland area due to forest encroachment has profound implications for livestock grazing and biodiversity. Cattle herd size, or animal unit month (a.u.m.) allocations set in the 1960's, cannot be maintained at current levels for much longer. The diminishing grassland area results in reduced forage production and an inability to meet Forest Practices Code range management guidelines where cattle are increasingly concentrated onto a smaller grassland area. In terms of biodiversity, the Cariboo-Chilcotin grasslands are a major part of the biodiversity of British Columbia. Although they occupy less than 2% of the Cariboo-Chilcotin area, available inventory suggests they support more than 30% of the provincial species of concern. Forest encroachment of grasslands is resulting in loss of critical habitat area as well as a loss of habitat quality due to increasing concentration of livestock grazing on remaining grassland and riparian areas.

Eight options for a grassland benchmark area are described. Each of them is evaluated in terms of 1) ability to achieve Cariboo-Chilcotin Land Use Plan (CCLUP) objectives (range, biodiversity, and timber), 2) availability and quality of information for describing the benchmark area, and 3) suitability of the benchmark for applications in land use planning and operational prescriptions. The recommended option is the area of "open range" shown on earliest available Ministry of Forests inventory maps, completed between 1963 and 1975 for most grassland portions of the Region. By the date of the CCLUP release (1994), inventory reclassification projects, used to update the initial inventory mapping, had been completed for a large portion of the Cariboo Forest Region. However, the reclassified portions of the Region included only 26% of the total area of open range shown on the current inventory maps. The remaining area of open range is unchanged from the initial inventory, with the exception of inventory updates associated with harvest blocks and roads. As a result, the area of open range on the early inventory maps is estimated to be only 3,261 ha larger than that shown on inventory maps current in 1994.

Open range is an inventory mapping classification that does not include grasslands too small to map but does include scattered trees and stands of trees too small to map within a larger grassland area.Tree cover guidelines for the benchmark area are based on a goal of restoring this area to a condition like that which characterized it prior to European settlement. Most large old trees and snags should be retained while most

smaller trees and regeneration should be removed. Removal of young, recently established trees is a priority.

Implementation of the recommended benchmark will provide an open grassland area sufficient for meeting livestock a.u.m. targets set in the CCLUP, as long as tree densities and forage production in forests adjacent to the grasslands are also restored to earlier levels. It is unlikely that a.u.m. targets as well as range management guidelines in the Forest Practices Code can both be met without reducing these tree densities.

The recommended benchmark is significantly smaller than the area of grassland that was present on the pre-European settlement landscape. As a result, it will entail increased risks to biodiversity and endangered species habitats compared to the earlier landscape. However, risks are significantly lower than if no effort is made to control forest encroachment. At the present rate of encroachment, grasslands in the Cariboo-Chilcotin will cover only about 61% of their current area 120 years from now. This would have an unacceptable impact on biodiversity due to loss of habitat and increased grazing pressures on the remaining grasslands and wetlands.

The recommended grassland benchmark entails an acceptable level of risk to biodiversity as long as tree densities in forests adjacent to the grasslands are also reduced. Many species depend on the open forests adjacent to the grasslands.

Implementation of the grassland benchmark may present some harvesting opportunities in the short and medium term. Some commercial sawlogs are available however the majority of the trees are small. Potential harvest is therefore linked to market viability for alternative products like fence posts, chips and Christmas trees.

Control of forest encroachment on the benchmark area will limit the potential long-term increase in the area of forest in the region. If the rate of encroachment continues at current levels and no effort is made to control it, the potential forest area will increase over the 120 year period following 1965 by an estimated 85,896 ha. Although this area of encroachment would represent a 39% reduction in the area of open range, it would represent less than a 1.5% increase in the area of forest.

Implementation of the recommended benchmark would decrease forest area by an estimated 3,261 hectares across the region. This decrease is modest since only 26% of the OR area has been reclassified since the benchmark period and only a very small part of the reclassified area is considered to have become treed.

Principal recommendations arising from the assessments presented in this report are:

1. The area of open range on earliest available Ministry of Forests inventory maps, prepared between 1963 and 1975 should be designated as a grassland benchmark area.
2. The open range polygons on these early Ministry of Forest inventory maps should be retained as a separate layer in current and future inventory data bases in order that the benchmark area does not contribute to long-term timber supply.
3. The Ministry of Forest should be the lead agency for implementing grassland restoration on the benchmark area. An implementation co-ordinator should be designated in each forest district to oversee restoration activities.
4. The grassland benchmark area and restoration objectives should be incorporated into the current landscape unit planning processes in each forest district.
5. Treatments to control recent forest encroachment should be initiated on priority sites as soon as possible.

Additional recommendations are contained in the Recommendations Section.

1.0 Introduction

1.1 Directions from IAMC

The Cariboo-Chilcotin Grassland Working Group was established by the IAMC to prepare a regional grasslands strategy. This first report by the working group provides an assessment of the current status and trends in grassland ecosystems for the Cariboo-Chilcotin. Based on those assessments, a recommended grassland benchmark is also provided and some preliminary management practices are recommended. Additional components of a grasslands strategy will be described in subsequent reports.

The major issue associated with grasslands in the Cariboo-Chilcotin is forest encroachment and forest in-growth leading to a continuous loss of grassland area and productivity. This situation is largely the product of the forest management system in place for many decades. Specifically, fire exclusion has profoundly altered the natural disturbance regime, so that landscapes once maintained by fire as open grassland are becoming treed (encroachment) and open forest area is closing in (in-growth).

There are compelling reasons for addressing the issues of forest encroachment and in-growth into grasslands. The Cariboo-Chilcotin Land Use Plan(CCLUP) clearly establishes targets and strategies for livestock grazing, biodiversity conservation, riparian areas, wetlands and grassland habitats. Other key values such as recreation, scenic, historical and traditional use by indigenous peoples are stated. In addition, the Forest Act directs the Ministry to encourage the maximum productivity of the range resource and to protect and conserve this resource.

Clearly, the management regime for grasslands, especially the establishment of a benchmark area, represents a profound social decision affecting many values. The interim report and the final grasslands strategy are intended to illustrate the importance of this issue and the potential consequences of alternative choices.

Consistent with the terms of reference for the Cariboo-Chilcotin Grassland Working Group (APPENDIX 1), the primary focus of the interim report is identification of a benchmark grassland area for the region. As such, the benchmark area pertains only to encroachment , not in-growth. Given the timeframe and information sources available, estimates of in-growth into open forest could not be assessed reliably. Since the benchmark only addresses encroachment, the practices recommended for grassland recovery in the interim report pertain only to encroached areas. In a subsequent report, the issue of in-growth into existing open forest stands will also be addressed and additional recommendations provided with respect to recovery of understory grassland condition.

1.2 Purpose and Objectives

1.2.1 Purpose

The purpose of the Interim Report is to address the principal issue of encroachment on the long term sustainability of grassland biodiversity, wildlife habitats, species, and forage resources in the Cariboo Forest Region.

1.2.2 Objectives

- To recommend a grassland benchmark area, to be managed as grassland.
- Recommend management objectives for grassland benchmark area.
- To evaluate the implications of the benchmark on forage production and AUM allocation, biodiversity, and timber.

These objectives are to contribute to the sustainability of grassland habitat and species while maintaining grazing targets as identified by the CCLUP.

1.3 Definition of Grassland and Open Range

This strategy applies to all grasslands within the Cariboo-Chilcotin Land Use Plan area. For purposes of this strategy, grasslands include all upland, well-drained areas on which the herbaceous component of the natural vegetation is dominated by grasses or grass-like plants and tree cover is less than 10%. Individual expanses of grassland may extend continuously over several hundreds of hectares or may cover less than one hectare. Upland shrubs, such as big sagebrush and rabbitbrush, may be abundant (20% cover) but in many grasslands they are absent. When heavily disturbed, the vegetation of grasslands may be locally and temporarily dominated by forbs. Grasslands do not include wetlands although wetlands should be considered a vital component of an overall grassland management strategy due to their linkages to grasslands. In addition, grasslands do not include recently cleared or logged sites which were long occupied by forests throughout historic time prior to clearing. Areas from which tree encroachment has been cleared that were grasslands within the last 100 years, are considered restored grasslands.

Open range (OR) is a Ministry of Forests mapping classification for grasslands. Open range generally has less than 15% cover of trees but may include small forest stands, too small to map separately, within an open range polygon. Small areas of wetlands may also be present. Open range includes essentially all grasslands as defined above except those patches of grassland too small to classify separately and steep, eroding terrain within grasslands that is classified as non-productive. Depending on the inventory classifier, open range may also include some areas that do not meet the above definition of grasslands since they are too wet or have forb dominated herbaceous vegetation. However, most wetlands and moist to wet shrublands are classified as wetlands or non-productive brush rather than open range within the forest inventory classification.

The total area of open range currently mapped in the Cariboo Forest Region is 215,071 ha. Approximately 75% of this open range occurs within 20 kilometers of the Fraser and lower Chilcotin Rivers. Since open range may contain small forest stands, wetlands, and other vegetation types, the total area of open range may be greater than the total area of grassland.

Grasslands and open range occur primarily in three biogeoclimatic units in the Cariboo Forest Region: the Fraser Very Dry Hot Variant of the Bunchgrass Zone (BGxh3), the Alkali Very Dry Warm Variant of the Bunchgrass Zone (BGxw2), and the Very Dry Mild Subzone of the Interior Douglas Fir Zone (IDFxm). (Figure 1) Grasslands in these three biogeoclimatic units are commonly referred to as the Lower Grasslands, Middle Grasslands and Upper Grasslands. The Lower Grasslands occur from the lowest elevations of the Fraser River valley up to about 650 m on lower and middle valley slopes. Sagebrush is common in these grasslands. The Middle Grasslands occur from about 650m to 900 m. Sagebrush is uncommon and, as in the Lower Grasslands, forests are generally restricted to north-facing slopes and moist ravines. The Upper Grasslands generally occur at elevations above 900 m. These grasslands occur in a transition zone between a predominantly grassland landscape at lower elevations and a predominantly forested landscape at higher elevations. Both grasslands and forests are common and both occur on a wide range of sites. Grasslands also occur in other biogeoclimatic units, primarily on south-facing slopes that are too dry for trees or in cold air accumulation basins that are too cold for trees. The estimated area of grasslands within biogeoclimatic units of the Cariboo Forest Region is in Table 1.

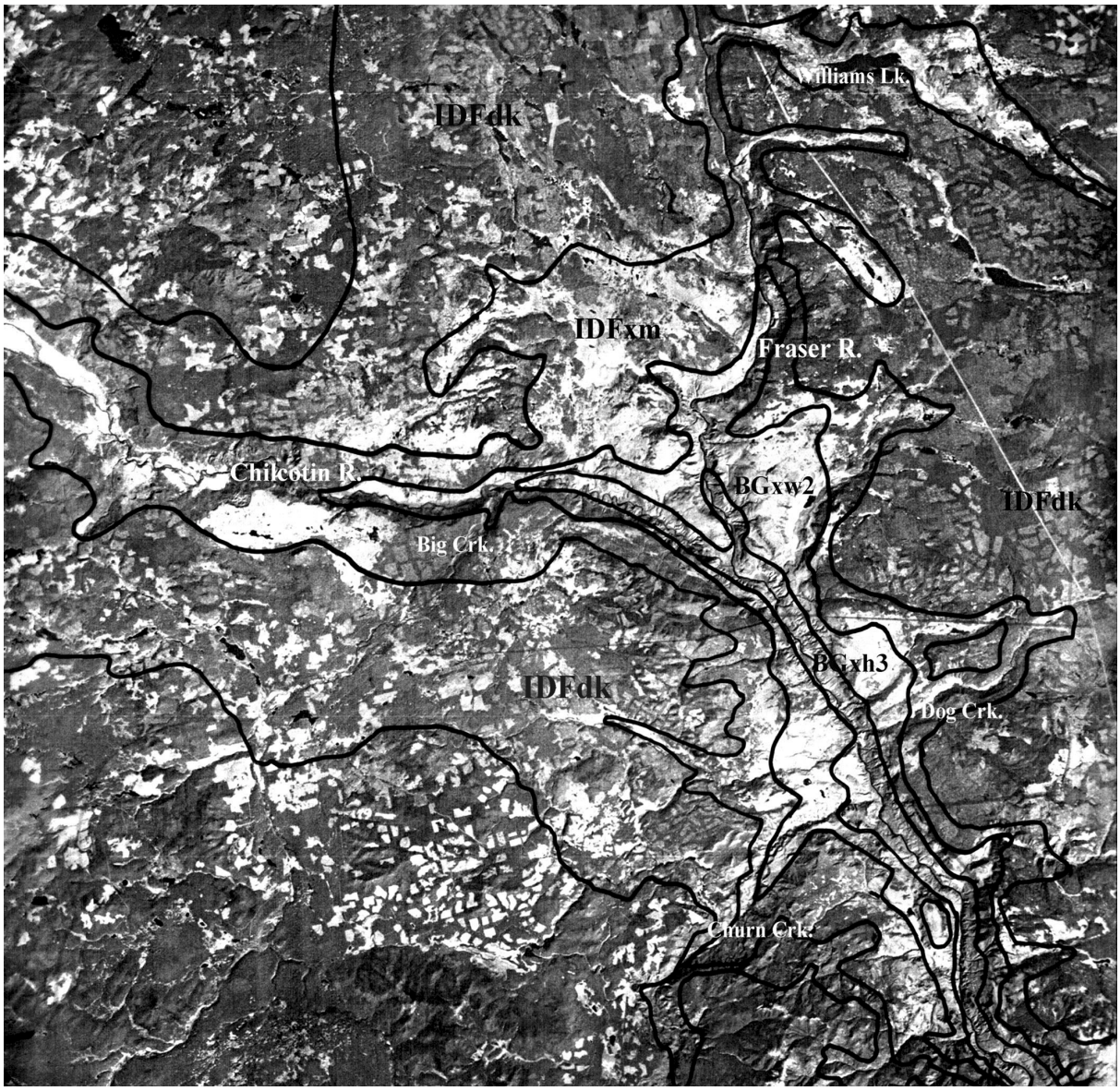


Figure 1. Satellite image of the principal area of grasslands in the Cariboo Forest Region, adjacent to the Fraser and lower Chilcotin rivers. Approximately 93% of the grasslands within the Cariboo-Chilcotin occur within the BGxh3, BGxw2, and IDFxm biogeoclimatic units.

Table 1. Estimated area of grasslands within selected biogeoclimatic units of the Cariboo Forest Region. Biogeoclimatic units with less than an estimated 1000 ha of grasslands are not included. Estimated areas are derived from known areas of each biogeoclimatic unit and estimates, by regional ecologists and range managers, of the percent of each biogeoclimatic unit which is grassland.

Biogeoclimatic unit	Estimated percent of unit that is grassland	Estimated area (ha) of grassland
BGxh3	90	24,210
BGxw2	75	50,160
IDFxm	25	71,190
IDFdk3	1	8,953
IDFdk4	1	3,994
SBPSxc	0.5	5,449

2. 0 BACKGROUND TO PRESENT SITUATION

2.1 Documentation of Encroachment

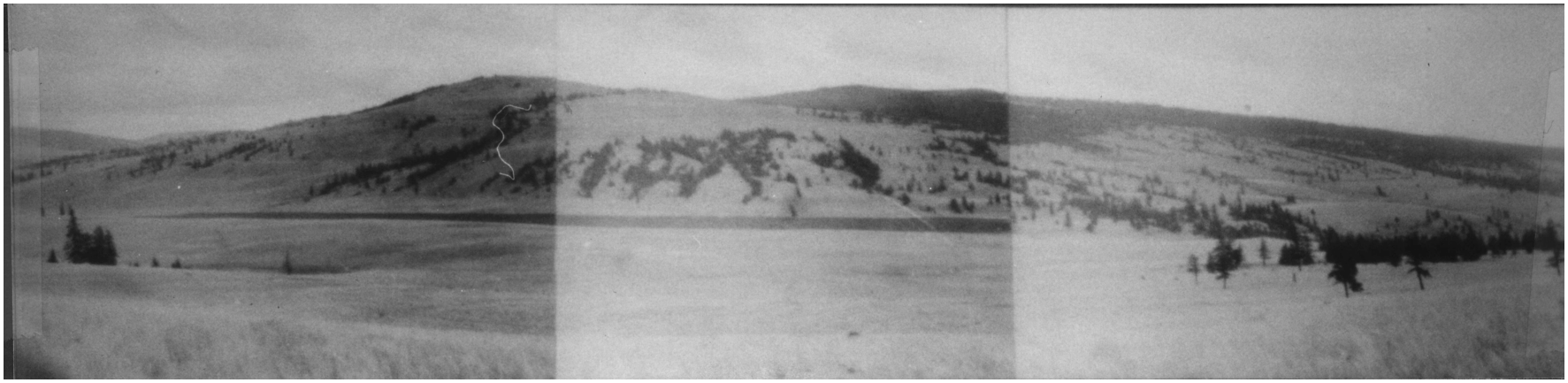
Forest encroachment and in-growth are significantly reducing the area of grasslands and open forests in the Cariboo-Chilcotin.(Figures 3 and 4) Forest encroachment, or the advancement of trees and other forest vegetation onto previously open grasslands is reducing the area of grasslands while forest in-growth, the filling-in of open forests by tree regeneration, has greatly increased shading and resulted in reduced vigour and abundance of herbaceous vegetation under previously open-grown trees.

Forest encroachment onto the grasslands of British Columbia was noted more than 80 years ago (Whitford and Craig 1918). By 1950, the invasion of open grasslands and open forests by trees was noted to be a common phenomenon in the Interior of British Columbia (Tisdale 1950). In 1977, the Cariboo Cattlemen's Association outlined the issue in a submission to the Select Standing Committee on Agriculture of the provincial legislature (Strang and Parminter 1980) and more recently, the issue was identified as a major concern by the B.C. Cattlemen's Association (B.C. Cattlemen's Assoc. 1997) and the Ministry of Forests (B.C. Ministry of Forests 1994). Concern over forest encroachment of grasslands is not restricted to B.C. but has also been identified in several areas of western North America (Arnold 1950, Rummel 1951, Sindelar 1971, Clary 1975).

Forest encroachment and in-growth in the Kootenay region has been shown to result in significant decreases in the area of open grassland and sparsely treed grassland but increases in the area of forest (Braumandl 1995, Taylor and Baxter 1998). Prescribed burning or thinning programs will be required to achieve or maintain grassland and open forest targets established by the Kootenay Boundary Land Use Plan (Taylor and Baxter).

In the Cariboo Forest Region, changes in the area of grasslands and forests between 1962 and 1993/1995 have been documented by Ross (1997) on two areas within the IDF biogeoclimatic zone near Riske Creek. The first area includes approximately 10,000 ha within the Bald Mountain Range Unit while the second area includes approximately 20,000 ha within the Becher Prairie Range Unit. Ross mapped areas of open grassland (= 5% tree cover), treed grassland (6 - 15 % tree cover), open forest (16 - 35% tree cover), and closed forest (> 35% tree cover) on 1962 aerial photographs and again on 1993 or 1995 photographs.

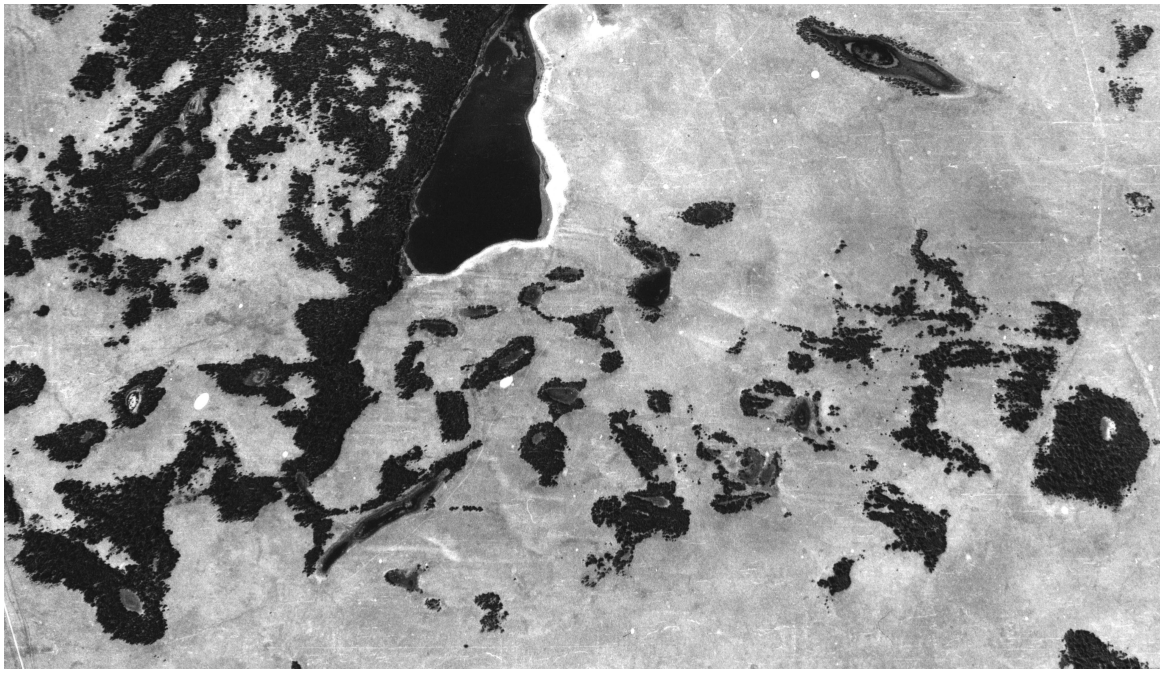
1912



1999

Figure 3. Comparison of 1912 and 1999 grassland and forest cover on a west-facing slope near Big Bar Mountain, 100 Mile House Forest District. Photographs courtesy of BC Cattle Company.

1950



1995

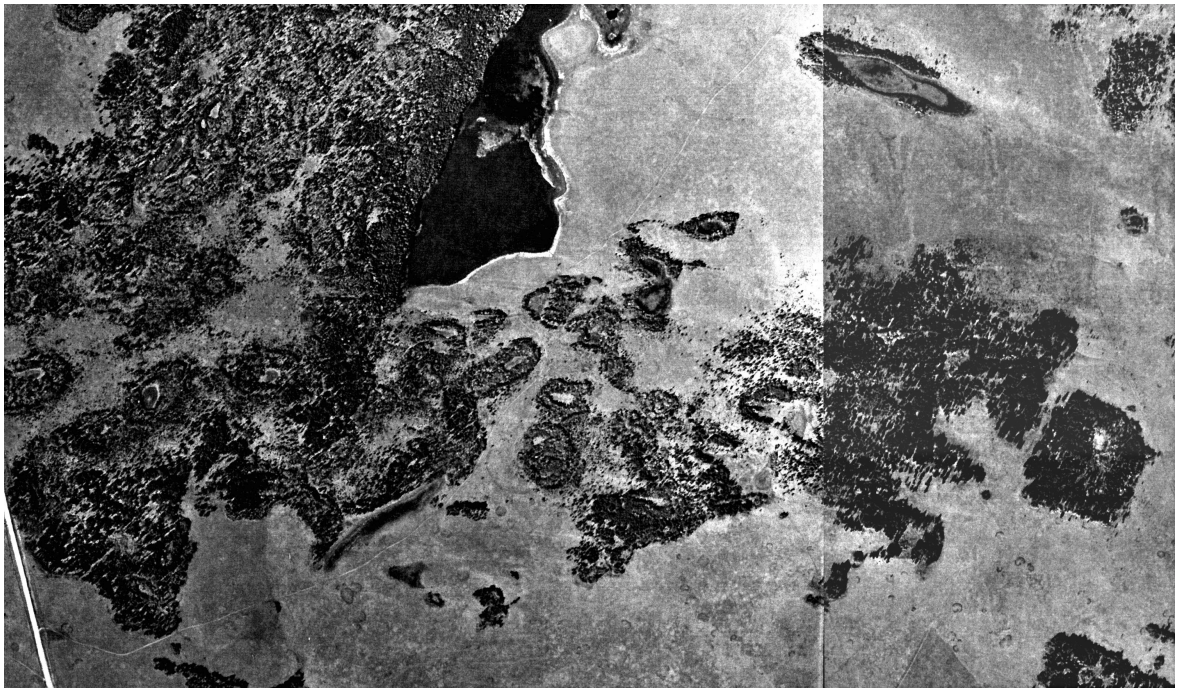


Figure 4. Comparison of 1950 and 1995 aerial photographs of Rock Lake area, Becher Prairie, showing changes in extent of forest cover.

Comparisons between the two dates of photographs indicated that open grassland was reduced from 2844 ha to 1972 ha on the Bald Mountain area and from 7942 ha to 5038 ha on the Becher Prairie area (Figure 2). These represent a reduction in the area of open grassland by about 31% and 37% respectively over the 32 year period. The total hectares of treed grassland and forest (including logged mature forest) increased by about the same amount. The greatest increases were for closed forest (4068 ha to 6144 ha) on the Bald Mountain area and for the combined closed forest/logged area (9463 ha to 11638 ha) on the Becher Prairie area. Ross (1997) concluded that forest encroachment is currently more prevalent than forest in-growth in the Becher Prairie and Bald Mountain areas. However, he acknowledges that in-growth may have already occurred on most sites.

The principal species of tree encroachment in the Cariboo-Chilcotin is Douglas-fir although lodgepole pine is also important, especially on Becher Prairie where it is the principal species of encroachment (Ross 1997).

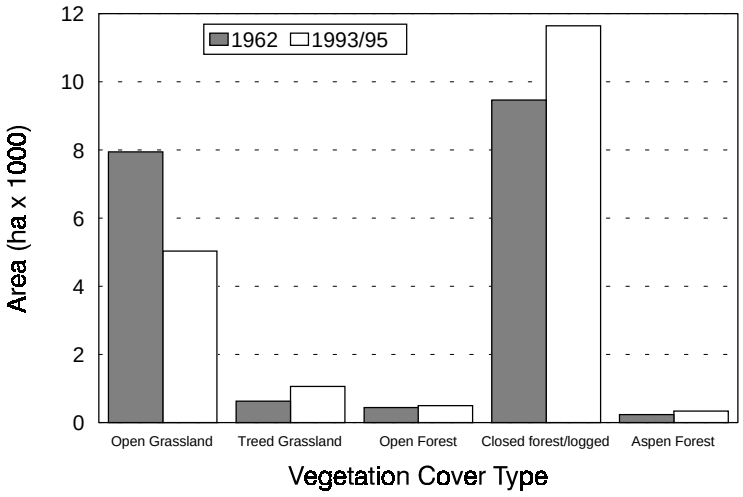


Figure 2. Changes in the area of forests and grasslands on Becher Prairie from 1962 to 1993 documented by Ross (1997) from a comparison of aerial photographs. The closed forest and logged forest categories described by Ross (1997) have been combined for purposes of this report.

The Becher Prairie and Bald Mountain grasslands assessed by Ross (1997) are part of the Upper Grasslands of the Interior Douglas-fir Biogeoclimatic Zone. These grasslands have a cooler, moister climate than the Middle and Lower Grasslands of the Bunchgrass Zone and, as a result, may be expected to have more forest encroachment. Since about 60% of the grasslands within the Cariboo Forest Region are within the Bunchgrass zone, further assessments are needed in order to document to magnitude of forest encroachment within the Region as a whole.

In the absence of further detailed assessments, similar to those conducted by Ross (1997), in the Cariboo Forest Region, the Grassland Strategy Committee conducted preliminary assessments of forest encroachment in two areas. Each of these areas include an elevation transect from the Fraser River to the adjacent plateau, with representation of grasslands in the BGxh3, BGxw2, and IDFxm biogeoclimatic subzones. Changes in the vegetation cover types described by Ross (1997) were quantified by comparing two or three dates of aerial photography. These assessments are considered preliminary since areas of vegetation cover types were measured directly from aerial photographs without transferring classification boundaries to a map base. Aerial photographs with type-line boundaries were scanned and areas measured on the scanned image by computer-based area measurement software (Sigma Scan Pro). Biogeoclimatic unit boundaries were not drawn on the aerial photographs and thus changes in cover types were not assessed by biogeoclimatic unit.

The first area assessed by the Grassland Strategy Committee includes approximately 2800 ha on the west side of the Fraser River in the Word Creek drainage. It includes the Lower Grasslands (BGxh3 biogeoclimatic unit) adjacent to the Fraser River and extends westward for approximately 5 km up to the continuous Douglas-fir forests of the IDF Biogeoclimatic Zone. Slopes are predominantly east facing. This area was selected because it includes the southern-most area for which available 1950 aerial photography includes lands adjacent to the Fraser River. A comparison of three dates of aerial photography (1950, 1965, and 1995) were used to assess changes in the area of closed forest, open forest, treed grassland, and open grassland cover types as defined by Ross (1997). The 1965 photography was selected since it is the date of photography used by the Forest Service in 1966 to outline areas of open range on the current forest inventory maps.

Results from the assessment of the Word Creek area are consistent with results reported by Ross (1997) for the Becher Prairie and Bald Mountain areas. From 1950 to 1995, the area of open grassland decreased by an estimated 42%, from 1376 ha to 801 ha (Figure 5). The greatest rate of change in area of open grassland was in the 1965 - 1995 period. The average annual rate of change during the period 1950 - 1965 was about 0.6% compared to 1.2% during the period 1965 - 1995. The areas of forest and treed grassland all increased, with the greatest increase in the area of closed/logged forest. Forest encroachment was predominantly in upper elevations of the area, in the IDFxm and upper elevations of the BGxw2.

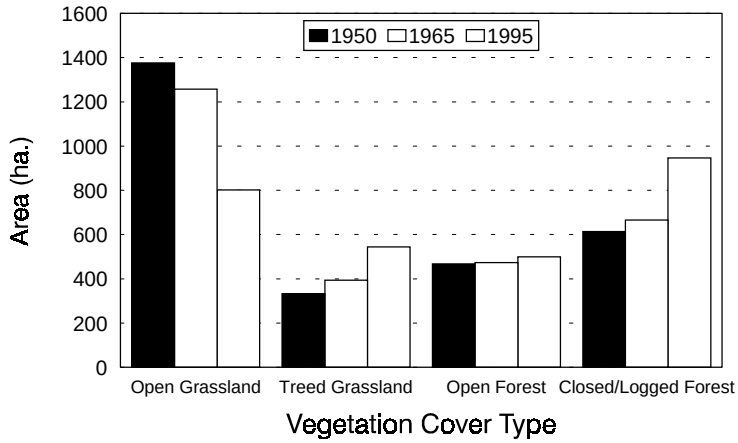


Figure 5. Changes in the area of forests and grasslands in the Word Creek area from 1950 to 1965 and 1995. The forest categories include both coniferous and deciduous forests.

The second area assessed by the Grassland Strategy Committee is across the Fraser River from the Word Creek area, just south of Meason Creek. This area, totalling about 2,000 ha, was selected since it is at the same latitude as the Word Creek area but on predominantly west-facing slopes in contrast to the east-facing slopes of the Word Creek area. The assessed area is approximately 7.2 x 2.7 km and extends from the Lower Grasslands (BGxh3) adjacent to the Fraser River into the Upper Grasslands (IDFxm) on the plateau east of the Fraser River valley. Douglas-fir forests are extensive at the upper elevations of the area. The assessments of this area were based on comparisons of 1974 and 1995 aerial photographs. The 1950 photography held by the Forest Service in Williams Lake did not include this area and the 1965 photography used for the Word Creek area did not cover this area. The 1974 photography was selected for this assessment since it is the date of photography used by the Forest Service in 1976 to delineate open range on the current forest inventory maps of this area.

The rate of forest encroachment, and consequent reduction in the area of open grassland, in the Meason Creek area has been smaller than that in the Word Creek or Becher Prairie and Bald Mountain areas. In the 20 years between the two dates of photography, the area of open grassland has decreased by about 11%, from approximately 1201 to 1068 ha (figure 6) for an average annual rate of decrease of 0.5%. The area of closed/logged forest, open forest, and treed grassland all increased, with the greatest increase in the closed logged forest, from 430 to 527 ha. The area of closed forest decreased from 348 to 215 ha while the area of logged forest increased from 81 to 313 ha.

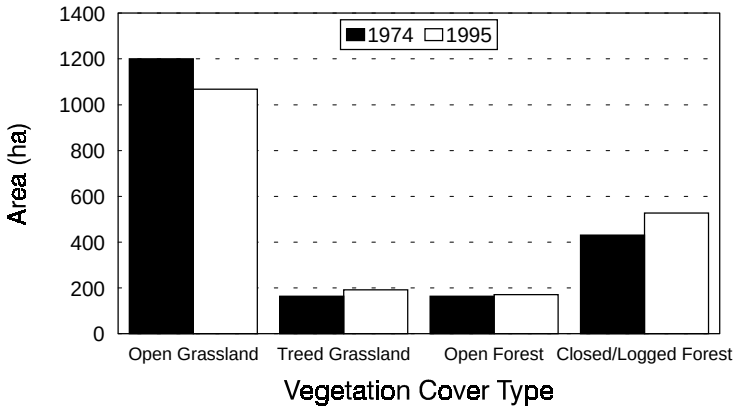


Figure 6. Changes in the area of grassland and forest in the Meason Creek area from 1974 to 1995. The forest categories include both coniferous and deciduous forests.

Assessments of the Word Creek and Meason Creek areas indicate that:

- rates of encroachment similar to those reported by Ross(1997) have likely occurred in at least some other grassland areas, even those with both Bunchgrass and Interior Douglas-fir biogeoclimatic zones;
- rates of encroachment are probably variable and, at least in some areas, are lower than those reported by Ross (1997) for the Becher Prairie and Bald Mountain areas;
- rates of encroachment are probably lower in the Bunchgrass than the Interior Douglas-fir biogeoclimatic zone.

The rate of tree encroachment and in-growth has not been constant in the Cariboo-Chilcotin but rather has been characterized by periods with a high rate of establishment followed by intervals with relatively low rates of establishment. Strang and Parminter (1980) concluded that encroachment on Dester Ridge near Riske Creek began in 1931 and apparently permanently ceased in 1971. Peak rates of encroachment occurred from about 1941 to 1955.

Preliminary surveys of a wide area of grasslands in the Cariboo-Chilcotin by B.C. Forest Service staff indicate that, in addition to a peak of encroachment in the 1940;s, other major peaks in the rate of encroachment probably occurred in the early 1920's, early 1960's, and early 1980's (Table 2). Nearly even-aged stands of trees currently about 80, 50, 35, or 17 years old are common adjacent to the grasslands. Widely spaced older veteran trees are common in some of these stands, especially those which are about 80 years old. The apparent peak of encroachment in the early 1980's has resulted in a very large number of small trees, currently about 1 to 3 m tall, in many areas of Cariboo-Chilcotin grasslands. There has apparently been relatively little new encroachment since the early 1980's although in-filling beneath trees established at an earlier time is more nearly continuous. Another wave of encroachment may be expected in the future.

Table 2. Dates of apparent peaks in the rate of establishment of trees in grasslands and open forests, based on a preliminary reconnaissance of tree stand ages adjacent to grasslands in the IDFxm, BGxh, and BGxw biogeoclimatic subzones.

Dates	Comments
1915 - 1925	A period of apparently very extensive encroachment and ingrowth throughout the grassland and dry forest portions of the Region.
1940 - 1950	A period of apparently very common establishment of trees in grasslands, especially in central and southern portions of the Region
1960 - 1965	An apparently small peak of tree establishment in grasslands throughout the Region; apparently not extensive.
1980 - 1983	A period of very extensive establishment of trees in upper elevation grasslands, especially in central and northern portions of the Region; the most recent peak of tree establishment in grasslands.

Based on interpretations of 1950 aerial photographs, most of the in-growth in forests near the grasslands appears to have been initiated prior to 1950. That is, closed forests with scattered large trees and a dense layer of much smaller trees of relatively uniform height are apparent on these photographs. Limited surveys of understory tree ages beneath large old trees suggests that the major period of abundant tree establishment in previously open stands of large trees may have been in the early 1920's and possibly as late as 1940. Additional surveys are needed to confirm these preliminary conclusions.

2.2 Causes of Forest Encroachment

Several factors have probably contributed to forest encroachment and in-growth. A principal factor in the Cariboo-Chilcotin is the sharp reduction during historic times in the frequency of fires in grasslands and adjacent forests. Prior to the 1900's, periodic fires appear to have limited the number of trees establishing on the grasslands and maintained large areas of the forests in an open condition. Fire scarred trees in Douglas-fir forests of the dry Interior indicate that fires of sufficient intensity to cause a scar occurred on average about every 7 to 20 years (Parminter 1978, Strang and Parminter 1980, Arno 1980, Gayton 1996, Parminter and Daigle n.d., Gray and Riccius 1999). The frequency of these fires was sufficient to kill recent encroachment and in-growth before it had a chance to develop a thick basal bark sufficient to insulate the cambium from the heat of a surface fire. Young encroachment also consistently has a low branching habit which encourages burning of the entire tree.

Many of these fires were likely initiated by lightning strikes to trees in or near the grasslands. However, the frequency of fires was generally too high to be easily explained by lightning alone. In fact, the majority of fires may have been purposefully initiated by aboriginal peoples. Aboriginal peoples used fire for probably thousands of years as a management tool to improve hunting prospects, enhance production of certain foods and special purpose plants, clear campsites, and reduce the threat of a damaging wildfire (Parminter and Daigle n.d. By the early 1900's however, as ranches and other developments occurred in the Cariboo-Chilcotin, aboriginal peoples no longer initiated frequent fires and wildfires virtually stopped. In addition, domestic grazing reduced grassland litter and standing biomass and thus the fuels required to carry a fire (Strang and Parminter 1980). Although domestic livestock grazing is currently less intense than it was in the 1920 - 1930 period and grassland fuels have reached high levels in many areas, organized fire control now limits the frequency of wildfires on the grasslands.

On Dester Ridge near Riske Creek, Strang and Parminter (1980) concluded that no fires sufficient to scar a tree had occurred since 1926, although prior to that time, the mean fire frequency was 9.8 years. This marked decrease in fire frequency on the Cariboo-Chilcotin grasslands occurred prior to organized fire control, which was not initiated in the Riske Creek area until the early 1960's.

Annual climatic variations do not appear to be correlated to rates of encroachment. Strang and Parminter (1980) could find no evidence of precipitation or temperature shifts in weather data from 1904 - 1977. Further, years of peak establishment of trees on the grasslands showed no apparent correlation to annual meso-scale climatic fluctuations. It is possible that variations in rates of tree establishment on the grasslands may be related to micro-scale climatic fluctuations in combination with variations in Douglas-fir and lodgepole pine seed production. Tree invasion of grasslands in western Montana has been shown to be related to periods of unusually wet spring weather combined with intensive grazing by domestic livestock and suppression of fires (Sindelar 1971).

Livestock grazing may have also increased tree establishment on the grasslands by reducing the biomass of grasses and thus reducing grass competition with trees (Strang and Parminter 1980 Walker et al. 1981). Grasses are more efficient than trees in extracting water from upper soil layers and thus they reduce the volume of water percolating to a depth where tree roots are more abundant than grass roots. However, recent (12 - 17 year old) encroachment in the Cariboo-Chilcotin grasslands is often as dense in relatively ungrazed grasslands with vigorous grass cover as it is in moderately to heavily grazed grasslands with little above-ground grass biomass (Ross 1997). Reduced grass and grass litter biomass may also reduce the rate at which water percolates into soils, causing more water to runoff than be absorbed by the soil (Walker et al. 1981). As a result, less moisture penetrates to depths where tree roots are more abundant than grass roots.

2.3 Estimates of the Total Area of Encroachment in the Cariboo Forest Region

The reduction of grassland area due to forest encroachment in the Cariboo Forest Region is estimated in Table 3. This table includes only biogeoclimatic subzones that contain substantial area of grasslands, generally greater than an estimated 1,000 ha. The total estimated area of grasslands as of 1965 in these subzones (188,400 ha) is less than the total area of open range in the region (215,071 ha based on 1962-1974 inventories). The values may differ since open range includes vegetation types in addition to grassland and since small areas of grassland also occur in biogeoclimatic units other than those listed in the table. It must also be recognized that the area of grasslands in Table 1. are only best current estimates.

The estimated percent encroachment in Table 3 is a best estimate derived from studies described previously in this report and from extensive field observations by regional ecologists and range agrologists. The percent figures are estimates of the percent of total area in 1965 that is now treed (>15%tree cover) due to forest encroachment. Although the figures are estimates, they clearly indicate the general magnitude of encroachment and the relative differences between biogeoclimatic units.

An estimated 21,474 ha of grassland has been encroached by forest during the last 35 years in the Cariboo Forest Region (Table 1). A much larger area of encroachment likely occurred prior to 1965 and was noted to be an issue as early as 1918. The estimated magnitude of forest encroachment during the last 35 years in the Cariboo Forest Region is greatest in the IDFxm biogeoclimatic subzone. This is consistent with the fact that this subzone has a cooler and moister climate than the Bunchgrass (BG) subzones. The estimated area of encroachment since 1965 represents approximately 11% of the estimated total area of grasslands in Cariboo Forest Region.

Table 3. Estimated area of grassland and forest encroachment in biogeoclimatic units with significant grassland area in the Cariboo Forest Region

Biogeoclimatic (BGC) Unit	Total area of BGC unit[1]	Estimated total area (ha) of grassland in 1965	Estimated % encroachment[2] Since 1965	Estimated area (ha) of encroachment since 1965
BGxh3	26,900	24,700	2.0	494
BGxw2	62,700	52,200	4.0	2,088
IDFxm	237,300	85,400	20	17,080
IDFdk3	895,300	10,300	15	1,545
IDFdk4	399,400	4,200	5.0	210
IDFxw	36,200	200	1.0	2
IDFdw	100,900	500	0.0	0
MSxv	873,100	4400	0.5	22
SBPSxc	1,089,800	5500	0.5	28
SBPSmk	565,800	600	0.5	3
SBPSdc	422,700	400	0.5	2
TOTAL	4,710,100	188,400		21,474

[1] Total area determined from GIS assessment of regional biogeoclimatic map.

[2] Percent encroachment estimates were derived from the quantitative estimates based on aerial photo analysis in combination with estimates provided by Ministry of Forests regional ecologists and range agrologists based on extensive observations. These estimates should be considered preliminary. Estimated total grassland area (188,400 ha) is smaller than total “open range” area (215,071 ha) on current forest inventory files for the Region probably since the latter is a mapping classification which includes some proportion of forest and other vegetation types in addition to grasslands. In addition, a small area of grasslands occurs in biogeoclimatic units not listed in this table. Estimated area of grasslands in 1965 is derived from the current estimated area of grasslands plus the estimated percent encroachment since 1965.

2.4 Issues related to Forest Encroachment

2.4.1 Forage Production and AUM Allocations

The Cariboo-Chilcotin Land Use Plan (CCLUP)commits government to "maintain and enhance existing Animal Unit Months (A.U.M.)"

The existing levels of use guaranteed in the CCLUP were largely established by the late 1960's. By then, government range staff had completed range management plans establishing stocking levels and dates of use which would ensure rangeland recovery from overuse beginning at the turn of the century. Range staffing levels had increased to monitor these plans and the level of management improved. The Grazing Range Improvement Fund (GRIF) returned rancher paid grazing fees to fund construction of range improvements.

The effects of past encroachment and in-growth were compensated for by the new reductions in numbers of permitted livestock which were far below historical cattle numbers and the new range construction projects. These projects brought the physical infrastructure necessary to graze cattle on areas previously not grazed by providing access, water developments, fences that forced cattle to graze in less desirable forested sites.

Today forage production continues to be eroded by forest encroachment and in-growth. Both open forests and grasslands contain many of the same plant species. These species provide the most nutritious and greatest volume of forage per hectare. Encroachment and in-growth shifts species composition to less palatable and less nutritious forest species.

The Cariboo-Chilcotin Land Use Plan (CCLUP) commitment to "maintain and enhance existing Animal Unit Months (A.U.M.s) are those safe, conservative limits established in the 1960's. The safety cushion built into those plans is quickly disappearing as the young tree seedlings which had negligible impact 20-30 years ago are now 5-10 meters tall trees occupying an area once covered by grass. It is time again to review and revise management plans to reflect changes in forage quality and production.

2.4.2 Loss of Biodiversity

Grasslands are a major component of the biodiversity of B.C. Inventory efforts have not been equal in all ecosystems but available information indicates that grasslands occupy about 1.8% of the province (About 2% of the Cariboo Forest Region),but they support 36% of the provincial species of concern, 11% of the provincial red-listed species, and 38% of the provincial blue-listed species (Hooper and Pitt 1994). Ungulates such as Mule Deer and California Big Horn Sheep also make extensive use of grasslands.

Grasslands in this region are also unique. Unlike the prairies, native grasslands in the Cariboo-Chilcotin are dominated by bunchgrasses. Western bunchgrass ecosystems extend well down into the Columbia Basin in the U.S.A. but the Cariboo Chilcotin grasslands occur at the northern limit of this range. As a result, our regional grasslands contain species that are not common elsewhere (Nicholson et al. 1991). For example, Stipa curtiseta grassland is found in places like Becher prairie in the IDF xm biogeoclimatic subzone, but it does not occur outside of the Cariboo-Chilcotin. Similarly the distribution of several sub-species of butterflies is limited to the Cariboo-Chilcotin grasslands (C. Guppy pers.comm[1].).

Open grasslands and open-canopied forests interspersed with small grasslands are both important to biodiversity. The complex of open forests with a grassy undergrowth to open grasslands with a few widely scattered trees, provides a wide range of sites for feeding , resting, hiding, nesting and rearing and a wide range of microsites for plant and lichen species. Consequently these areas have a relatively high species productivity.

[1] C. Guppy.pers.comm.1999. Forest Ecosystem Specialist, B.C. Environment, Quesnel Forest District.

Riparian habitats in the grasslands are particularly valuable. Species diversity is especially high in these areas and studies of bird and insect fauna indicate some apparently unique characteristics of the grassland-wetland interface not found outside the Cariboo-Chilcotin (Hooper and Pitt 1995). The importance of aspen parkland in the Cariboo-Chilcotin for aquatic birds has also been noted as significant in Canada (Hooper and Pitt 1995). Damage to riparian habitats is linked to the concentration of domestic livestock which in turn relates to overall grassland abundance and quality. Both forest encroachment and forest in-growth threaten biodiversity values. Forest encroachment results in conversion of open grassland to forest, while in-growth shifts the character of the stand to closed canopy which in turn alters the understory composition through shading of soils. The diversity and mix of organisms dependent upon the understory is affected as the plant community of the forest floor changes.

Because there is diminished grassland area and decreased forage production in forests adjacent to the grasslands, domestic livestock become more concentrated on a smaller area. Over time, impacts from domestic grazing are increased on remaining grassland ecosystems. The problem becomes particularly acute with concentration of cattle in riparian areas. Distribution of domestic stock onto new clearcuts has helped to ameliorate, but not resolve the problem.

The CCLUP (p158) identified objectives for grasslands, including the management of critical habitat such as riparian and the maintenance of climax seral communities as described by the Biodiversity guidebook. Encroachment of grasslands by forests over time has made these objectives increasingly difficult to achieve.

One key measure of biodiversity is the retention of representative ecosystems in suitable seral condition. This is known as the coarse filter. With a diminishing grassland area, maintenance of AUMs for livestock not only prevents the achievement of climax seral communities, it further erodes the current suitability of the remaining grassland.

Late seral or climax grasslands, like old forests, provide specialized habitats often not found in younger seral stages. One characteristic of older seral grasslands that are not heavily grazed is the association of a significant cryptogram layer among the grasses. As seral condition of grasslands changes, species dependent on those specialized habitats will be affected. Moths and butterflies present a good example of the intimate associations that can exist. Some of these insects are known to depend upon a single plant genus to satisfy their feeding or reproductive requirements (C. Guppy, pers. comm.).

With respect to total species diversity, there are species that depend on late seral grasslands and those that prefer early seral. However, there is evidence that overall diversity and density of birds is greatest in ungrazed or lightly grazed grassland systems (Hooper and Pitt 1995). Similarly, butterfly diversity appears to be greatest in grassland ecosystems that retain natural fire events and are only lightly grazed (C. Guppy, pers. comm.[2]).

As well as the maintenance of representative ecosystems and seral condition, the loss of productive native grassland ecosystems has threatened individual species. Conservation of individual species is known as the fine filter. Hooper and Pitt (1995) identified 276 vertebrate organisms having some association with grasslands in the BGxh, BGxw and IDFxm subzones of the Cariboo Chilcotin . The relative importance of grasslands to species at risk is shown by the high number of red and blue listed species associated with these BEC types.

[2] Ibid

Table 4. Distribution of Red and Blue-Listed Species by BEC Zone in the Cariboo Forest Region

Forest District	Number of species in all BEC zones	Number of species in BG and IDF zones	Proportion(%) in the BG and IDF zones
100 Mile House	17	13	77
Chilcotin	41	21	51
Williams Lake	30	27	90

Hooper and Pitt confirm that riparian and shrub-grassland habitats are the most critical habitat types with respect to supporting red and blue-listed species.

One of the problems in assessing impacts to biodiversity is the lack of inventory. Appendices 3 and 4 list some of the grassland-associated species of concern in the region. The poor state of local grasslands inventory was illustrated by the recent discovery of three new bat species (Western Small-footed Myotis, Fringed Myotis, and Spotted bat) previously known only from the Okanagan region of B.C. (Roberts and Roberts 1992). All three are blue listed species.

The lack of inventory is especially significant for plants and non-vertebrate species in the grasslands. With changes to the species mix and structure of the grassland, losses and diminishment of many organisms can be occurring without our knowledge.

Clearly, the history of encroachment has threatened the maintenance of biodiversity at both the coarse and fine filter levels in the Cariboo-Chilcotin. Despite objectives specified in the CCLUP to manage for biodiversity and improve seral condition in native grasslands, forest encroachment is causing theopposite trend. When the CCLUP objectives of maintaining AUMs for grazing are also considered, that negative trend may be accelerated. As a consequence, the first step towards meeting the CCLUP objectives for biodiversity must be to recover encroached grassland habitats.

3.0 APPROACH

An overall approach for management of forest encroachment and in-growth should consist of two parts:

1. establishment and maintenance of a grassland benchmark area; and
2. stand structure management, primarily to reduce stem densities, in forests adjacent to the benchmark area.

Although this report focuses only on a grassland benchmark, both parts of the overall approach are introduced here in order to provide a broader context for the report. It is intended that recommended guidelines for stand structure management will be developed in the final report prepared by the Grassland Strategy Committee in the next year.

3.1 Establishment and maintenance of a grassland benchmark area

The most important component of the approach to manage forest encroachment in the Cariboo-Chilcotin is the establishment and maintenance of a grassland benchmark area. This is an area that will be identified and managed in perpetuity as grassland rather than forest. It will be established with the goal to ensure continued opportunity to meet forage, biodiversity, and other resource needs associated with grassland ecosystems.

In addition to identifying a grassland area, the grassland benchmark will identify a desired condition for that area in terms of tree cover, grassland seral stage, and human use. Grassland seral stage and human use guidelines will be described in the final report. Tree cover objectives are described in this report.

3.2 Stand Structure Management

Grassland ecosystems do not exist in isolation from the adjacent, surrounding forests. A strategy to manage grasslands to maintain forage and biodiversity values must also consider management of the adjacent forests. Domestic livestock have historically utilized the open forests adjacent to grasslands for foraging and resting. Many grassland wildlife species also rely on the open, grassy forests adjacent to the grasslands as well as on the grasslands themselves. In fact, for some grassland species, the open, grassy forests adjacent to the grasslands are more important for their life stages than are the adjacent open grasslands.

Due to extensive forest in-growth, tree densities in forests adjacent to the open grasslands have increased markedly in the last 100 years. Increased tree densities have substantially altered the environment of these previously open stands and resulted in greatly decreased production and diversity of forage and other grassland plant species. This change may have had a greater impact on biodiversity than the current reduction in grassland area.

The second part of the grassland strategy for dealing with encroachment and in-growth will be included in the final report and will focus on developing guidelines for stand structure management in forests adjacent to the grassland benchmark area. These guidelines will be based on an ecological site classification and will consider the condition of these forests prior to European settlement. Guidelines will include stand density reductions, especially densities of smaller stems. Many of these stems are of merchantable size.

4.0 Grassland Benchmark Options

4.1 Criteria for selecting benchmark area.

Encroachment and in-growth have steadily diminished the area of grasslands in the Cariboo-Chilcotin over the last 100 or more years. As a result, a grassland benchmark area option can also be expressed as a benchmark date option. A later benchmark date results in a smaller benchmark area.

Selection of a recommended benchmark area must be based on an ability to provide a grassland area that meets the needs for domestic range, biodiversity conservation, timber production, and other resource objectives, as outlined in the Cariboo Chilcotin Land Use Plan. In addition, the benchmark area should be sufficiently well described to be readily identified and assessed for purposes of land use planning and operational prescriptions.

The following are the principal criteria used to evaluate and select a recommended grassland benchmark area.

1. The benchmark area must be adequate to achieve CCLUP targets for domestic grazing, biodiversity conservation, and timber production. The benchmark area must be sufficiently large and well distributed to meet domestic grazing and biodiversity targets while not negatively impacting the ability to meet timber production targets within the region. In order to meet grazing targets, the benchmark area must consider current animal unit month (AUM) commitments in the CCLUP. To meet biodiversity targets, the benchmark area should approximate, to the extent possible, the area and tree cover characteristics of grasslands within the region prior to reductions in fire frequency and subsequent forest encroachment and in-growth. In order to meet timber production objectives, the benchmark area should have minimal impact on the area available for timber harvest as described in the CCLUP.
2. The benchmark area must be based on quality information. Information of generally accepted quality must be available for documenting the total area and specific location of benchmark grasslands within the Cariboo-Chilcotin Land Use Plan (CCLUP) area
3. The benchmark area must be adequately described for applications in land use planning and forest and range operations. The benchmark grassland area must be sufficiently well described and readily available that it can be applied in land use planning processes as well as operationally on the ground. It should be possible to assess the total area of the benchmark area within a planning area and monitor changes against the benchmark over time. As well, the benchmark area should be sufficiently well described that site specific boundaries between the benchmark area and adjacent forest land can be reasonably well identified.

4. The benchmark area should be identifiable from existing information. The benchmark area should not require additional extensive surveys or mapping that would delay the implementation of the benchmark.

4.2 Benchmark Area Options

4.2.1 Procedure for Selecting Benchmark Area Options

A very large number of potential benchmark area options are possible. However, only a small number of these are meaningfully different and also satisfy at least some of the criteria described above.

The following three categories information were reviewed in order to identify benchmark area options:

- historic changes in land management practices (post-European settlement) which have affected the rates of encroachment and in-growth;
- dates of apparent peaks in rate of forest encroachment and in-growth over historic time; and
- sources of information for assessing the area of grasslands at a particular date.

Currently available pertinent information in each of these three categories is summarized in Table 5. In this table, the third category listed above, sources of information for assessing the area of grasslands, is subdivided into forest inventory information and other sources of information. The following sections further describe the information in each of these categories and how this information was considered to develop a list of benchmark area options.

Historic changes in land management practices affecting encroachment. The principal change since European settlement is the frequency of grassland fires. Prior to the middle of the 19th century, grassland fires were much more frequent than later and were probably initiated primarily by aboriginal peoples and, to a lesser extent, by lightning. Fire frequency appears to have decreased significantly after large ranches became established, European settlements were initiated, and aboriginal peoples were concentrated in localized reserves. Continued heavy grazing by domestic livestock from 1860 to 1930 or later, resulted in significant decreases to grassland fuels necessary to carry a fire, further diminishing the frequency of fires. Reductions in cattle number and improvement in cattle management practices by the mid 1900's resulted in increases in grassland fuels but by about this time (generally by 1960) fires were further controlled by systematic fire suppression activities by the B.C. Forest Service. Localized cutting of small trees on the grasslands was carried out by the B.C. Forest Service after about 1965. Controlled burning was used locally by the Ministry of Forests between about 1980 and 1995 to reduce forest encroachment.

A grassland benchmark date of about 1860 or slightly earlier would be the latest date at which a benchmark would represent a grassland area that was not influenced by European settlement. It could be considered to represent a natural grassland area for purposes of biodiversity conservation, although it is recognized that it would be only a snapshot in time and other natural grassland areas could also be identified. However, any later date would reflect the influence of large ranches and European settlements and thus reduced burning by aboriginal peoples compared to previous millennia. Fire suppression and removal of grassland biomass by grazing has continued to favor encroachment. Encroachment control measures by the B.C. Forest Service have affected only a limited area of encroachment.

Table 5. Factors considered in the development of benchmark area options

	1860	1900	1910	1920	1930	1940	1950	1960	1970	1980	1985	1990	1995	2000
Historic changes in land management practices affecting encroachment and in-growth	Frequent (10-20 yr return) fires initiated by aboriginal people and lightning	Large ranches established; European settlements established	Fire use by aboriginal people declines, virtually stops	Grasslands fenced and heavily used by cattle, removing fuels for wildfires and altering seedbed conditions for trees			Improved range management increases grassland biomass in many areas		Systematic fire suppression initiated by MoF; limited cutting to clear encroachment		Limited burning by MoF to clear encroachment			
Dates of apparent peaks of forest encroachment and in-growth	Large grasslands and open forests maintained by frequent fires	Fire effects on encroachment and in-growth diminishing		Major encroachment peak; major in-growth peak			Major encroach-ment peak		Minor en-croach -ment peak		Major en-croach -ment peak		Little or no encroachment establishment	
Sources of information - Forest inventory	No systematic, region wide inventories of grasslands or open range						First systematic forest inventory (not available); Localized range maps.		Second (earliest available) systematic forest inventory; area of open range identified			Localized re-classifications; inventory mapping updated for ~2% of open range area		Localized VRI mapping and classification initiated
Sources of information - other	Encroachment back-modelling; on-site vegetation and soil sampling	Historic photographs; localized oblique aerial photographs; encroachment back-modelling; on-site vegetation and soil sampling					Earliest systematic aerial photos of grasslands (1948)		Systematic aerial photos of grasslands west of Fraser R. (1962/65)	Systematic aerial photos of grasslands east of Fraser R. (1972/75)	Additional systematic aerial photography (1976-1997)		TEM projects completed for most large grassland areas	
Benchmark date options (date and name)	1. 1860 Pre-settlement		2. 1900 Early settlement		3. 1930 Post-early encroachment		4. 1947/50 Early aerial photography		5. 1962/74 First available systematic forest inventory		6. 1962/94 1994 forest inventory		7. 1990/95 TEM-based 8. 1993/97 1990 aerial photography	

Dates of apparent peaks of forest encroachment and in-growth. As described in Section 2.1, limited surveys by the Ministry of Forests indicate that there were peaks in the rate of encroachment during 1910-1925, 1945-1955, 1960-1965, and 1980-1983. The major period of forest in-growth appears to have been during the 1910 - 1925 period. A grassland benchmark date prior to about 1910 would apparently reflect a grassland area not substantially smaller than that which occurred prior to European settlement. A benchmark date of approximately 1930 would reflect a major encroachment peak and corresponding reduction in grassland area. Benchmark dates of 1955, 1965, and 1985, would reflect increasingly smaller grassland areas due to major peaks of encroachment. However two or more benchmark dates between these encroachment peaks would probably not have corresponding large difference in grassland area. For example, two benchmark dates later than 1965 but earlier than 1980 would have little difference in area of grassland due to the small amount of encroachment that apparently occurred between these times.

Sources of information: Ministry of Forests inventory classifications. Ministry of Forests inventory classifications can be a principal source of information for describing the area of grasslands. The first systematic forest inventory classification in British Columbia was conducted between 1952 and 1955. However, no digital versions of this inventory were produced and hard copy maps are not available. The second systematic forest inventory classifications in British Columbia was initiated primarily in response to the Sloan Commission report of 1959/1960. Inventories of portions of the Cariboo-Chilcotin with extensive grasslands was completed during 1963 (using 1962 photos), 1966 (using 1965 photos), 1972 (using 1972 photos), and 1975/76 (using 1974 photos) (Figure 6). Between 1985 and 1995, large portions of the Cariboo-Chilcotin region were reclassified, using new aerial photographs. However, these re-classifications were in primarily forested landscapes and affected only about 25% of the previously mapped open range. As a result, areas classified as open range on the current (1999) forest inventory maps are largely unchanged due to reclassifications from those on the maps prepared between 1963 and 1976.

A benchmark date of 1975 is the earliest date that would have the advantage of an available and complete systematic forest inventory classification of the region. The inventory classification would, however, be based on aerial photographs with dates ranging from 1962 to 1974. This may not be a large concern since there appears to have been no major encroachment peak between 1962 and 1974.

A benchmark date of 1995, or any other date after 1975, would be less well supported by inventory information since the available inventory information for that date would be based primarily on aerial photographs dated prior to 1975. Since there was a major encroachment peak in the early 1980's, 1995 maps do not reflect the extent of open range in 1995. The current inventory reclassification initiative known as Vegetation Resources Inventory (VRI), will update the area of open range when completed but, to date, VRI has been initiated only in local areas and has not been completed for any area in the region.

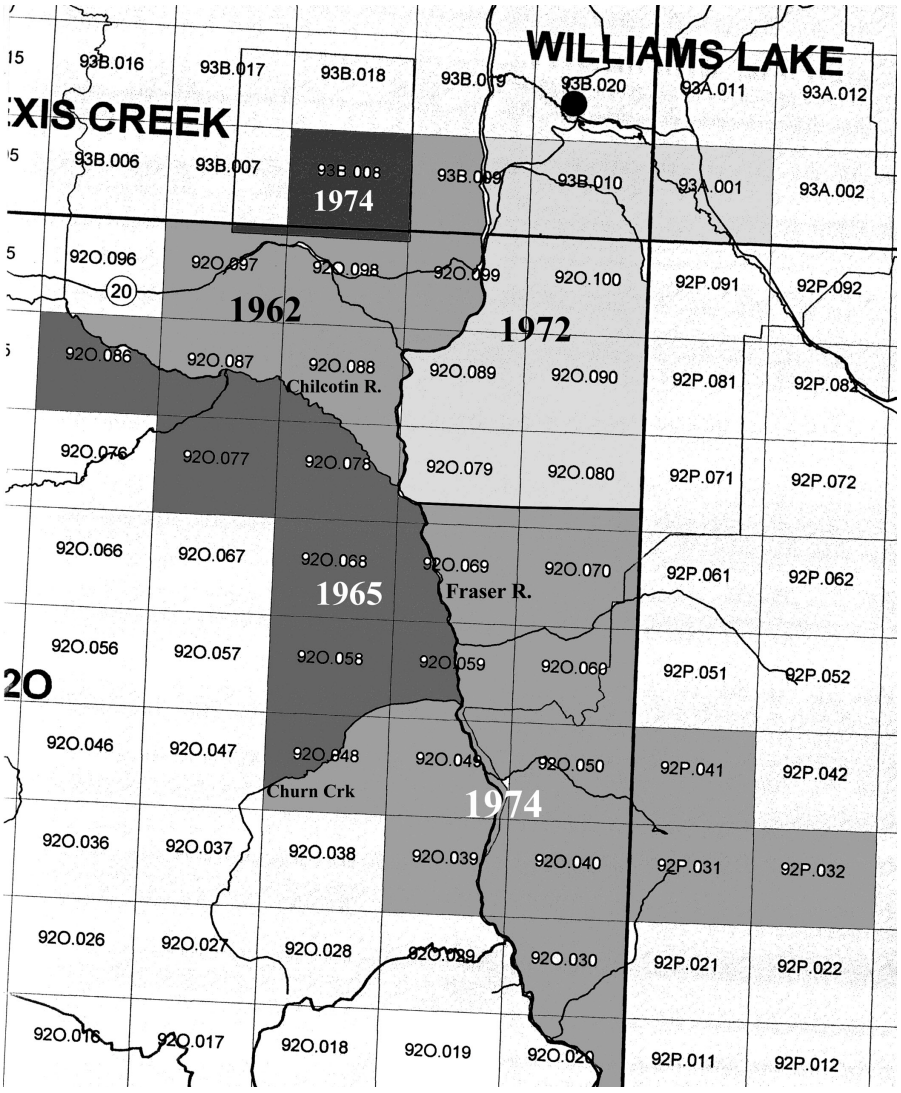


Figure 7. Dates of aerial photographs used to classify inventory cover types, including open range, and produce earliest available Ministry of Forests inventory maps and data bases. The shaded map sheets include about 80% of the open range within the Cariboo Forest Region. Only three of the shaded maps sheets (920 077, 920 086, and 920 087) have subsequently been reclassified using more recent (1986) aerial photograghs.

Sources of information other than Ministry of Forests inventory maps. Prior to 1948 there was no complete aerial photographic coverage of the principal grassland areas of the Cariboo-Chilcotin. Photograghs taken prior to 1948 include ground-level and aerial obliques of localized grassland landscapes.

Determination of the grassland area associated with a benchmark date prior to 1948 would require back-modelling of forest encroachment as well as on-site tree age sampling. Back-modelling would be used to

project the area of open range back in time, based on computer models, from the current forest inventory data. Modelling would be based on estimated past rates of encroachment. Local photographs and other information would assist the modelling. Back-modelling would provide an overall estimate of the total grassland benchmark area but would not identify site specific grassland boundaries. On-site sampling of forest vegetation and soils would be required to delineate specific benchmark boundaries between grassland and forest.

Systematic aerial photography, covering the grasslands in the Cariboo Forest Region, was produced during 1948-1950 and used for the first complete forest inventory of the region. Although the forest inventory maps are not available, this early photography could be used to classify and map grassland areas at a benchmark date of 1950.

Between 1962 and 1975, aerial photographs were produced for essentially all grassland areas within the Cariboo-Chilcotin, primarily for purposes of the second systematic forest inventory classifications of the province. Grasslands west of the Fraser River were flown primarily in 1962 and 1965, while grasslands east of the Fraser River were flown primarily in 1972 and 1974. Although these photographs are the basis of most current forest inventory maps in principal grassland areas, they can also be used for more detailed evaluations of grassland area at a 1962/1975 benchmark date.

Several additional aerial photographs of grasslands have been produced since 1975 and could be used for classification and mapping of grasslands. Dates of photographs covering significant portions of the grasslands are 1986, 1987, 1988, 1992, 1993, and 1995. Essentially all grasslands along the Fraser and Chilcotin rivers are covered by the 1986 photographs and by a combination of 1992 and 1993 photographs.

Terrestrial Ecosystem Mapping (TEM) projects have been completed for a major portion of the grasslands along the Fraser and Chilcotin rivers. TEM map units are based on Biogeoclimatic Ecosystem Classification (BEC) site series and consequently distinguish grassland from forest as well as distinguishing different ecosystems within grasslands and forests. Currently completed TEM maps are based on 1992 - 1995 aerial photographs. For areas in which TEM mapping has been completed, they could be used to define a 1992/1995 grassland benchmark area. However, TEM mapping has not been completed for all grasslands of the region.

4.2.2 Description of Benchmark Area Options

Eight grassland benchmark area options are listed on Table 5. These options have been selected to reflect the dates of significant land use changes, encroachment peaks, or availability of information on which to assess a benchmark area.

1. **Pre-settlement option (1860 reference date)** would establish a benchmark grassland area similar to the "natural" grassland area which probably existed for hundreds of years prior to European settlement. This option would be most consistent with principals of grassland biodiversity conservation. The benchmark area under this option could only be assessed by encroachment back-modelling and by on-site forest vegetation and soil sampling.

2. **Early settlement option (1900 reference date)** would establish a benchmark area probably only slightly smaller than that of the previous option. This benchmark area would not reflect the major encroachment peak in the 1910 - 1920 period but would reflect some encroachment and in-growth which probably occurred between 1860 and 1900. Definition of the benchmark area under this option would require encroachment back-modelling and on-site forest vegetation and soil sampling.

Post-early encroachment option (1930 reference date) would reflect the first apparently major peak of forest encroachment, prior to about 1925. The grassland benchmark area under this option would be significantly reduced compared to the previous two options. Definition of this benchmark area would require encroachment back-modelling and on-site forest age and soil sampling. A greater number of historical photographs are available for this than the previous two options. Current forest inventory

maps would aid the identification of benchmark grassland by identifying 80 to 100 year old forests, which may have become initially established in the 1915 to 1925 period. On-site surveys would be required to confirm establishment dates.

4. **Early aerial photography option (1950 reference date)** is the earliest option that could utilize aerial photography to identify a grassland benchmark area for the region. Since inventory maps produced from these photographs are not available, this option would require extensive aerial photo interpretation, classification and mapping. This option would reflect the major encroachment peaks of 1915 - 1925 and 1940 - 1955. The benchmark grassland area would be significantly reduced compared to previous options.

5. **First available, complete forest inventory option (1962 - 1974 reference date)** is the earliest benchmark date option that would utilize available inventory maps for assessing a benchmark area over the entire Cariboo-Chilcotin region. This benchmark area would be based on aerial photographs dated between 1962 and 1974. This benchmark area would reflect three apparent encroachment peaks prior to 1974 and a significantly reduced grassland area than contained in the first three options. The benchmark grassland area and the area of forest under this option are very similar to the total area of open range and forest assumed by the CCLUP (See Section 5.3 Timber).

6. **1994 forest inventory option (1962 - 1994 reference date)** would utilize the 1994 forest inventory data base and maps to describe a grassland benchmark area. This option would have a wide range of benchmark dates with the upper limit of this range (1994) corresponding to the date of the Cariboo-Chilcotin Land Use Plan. However, most of the benchmark area under this option would have a benchmark date between 1962 and 1974. The area of open range would be the same as that on the current (1999) inventory data and maps, but would differ only very slightly from Option 5 (First available, complete forest inventory option) since the current inventory of open range is based primarily on 1962 - 1975 aerial photographs. Reclassifications, based on later photographs (later than 1986), have affected only a small proportion of the total grasslands.

7. **TEM-based option (1993 - 1995 reference date)** would utilize Terrestrial Ecosystem Mapping (TEM) products to identify a grassland benchmark area for most of the region. Since TEM maps have not been completed for all grassland areas of the region, other sources of information would be required to fill-in where TEM maps are not available. This additional information could include new TEM mapping projects or substitution by standard forest inventory classification data. The latter would result in a mix of TEM and forest inventory classification data to identify the grassland benchmark area.

8. **1990's aerial photos (1993 - 1997 reference date)** option would utilize aerial photographs with dates corresponding as closely as possible to the date of the Cariboo-Chilcotin Land Use Plan (1994). Most of the grasslands area is covered by aerial photographs flown in 1993 or 1995. These would correspond most closely to the date of the Land Use Plan. Some additional photos flown in 1997 may be required. This option would require extensive new inventories of grasslands or open range based on aerial photo interpretations. The currently completed VRI mapping would contribute to this inventory.

4.3 Recommended Grassland Benchmark

4.3.1 Benchmark Area

The eight benchmark area options are listed in Table 6. and evaluated against the criteria described in Section 4.1.

Option 5 (First available,complete forest inventory; reference date 1962-1974) is the recommended grassland benchmark area. This option is based on quality information (forest inventory data base and maps) which is currently available for the entire forest region. No additional inventories are required. The benchmark area is well defined and suitable for strategic level planning as well as operational implementation. The inventory classification of forests and open range area under this option is the same as that used to develop the Cariboo-Chilcotin Land Use Plan for nearly 80% of the grassland area. As a result, impacts to the area of forest assumed available for harvest by the CCLUP would be small (approximately 0.07% decrease - see Section 5.3 Timber)

Option 1 (Pre-settlement - 1860) would not be based on current information. A very large effort, which would likely be prohibitive, would be required to identify a grassland benchmark area. Although this option would allow grazing and biodiversity targets in the CCLUP to be achieved or exceeded, impacts to timber would not be consistent with the CCLUP since a relatively large area identified as productive forest under the CCLUP would be managed for grassland.

Option 2 (Early Settlement - 1900) would also not be based on current information and a very large effort would be required to identify a grassland benchmark area. Although this option would allow grazing and biodiversity targets in the CCLUP to be achieved or exceeded, impacts to timber would not be consistent with the CCLUP since lands identified as forested by the CCLUP would be managed for grassland.

Options 3 and 4 (Post-early encroachment - 1930 and Early Aerial Photography - 1947 to 1950) would also not be based on current information and would require a large effort to identify corresponding grassland benchmark areas. Although these options should allow grazing and biodiversity targets in the CCLUP to be met, impacts to timber would not be consistent with the CCLUP.

Option 6 (1994 Forest Inventory - 1962 to 1993) is similar to option 5 except that the benchmark area would incorporate forest inventory reclassifications which have occurred in the last 20 years, resulting in a very wide range of benchmark dates, ranging from 1962 to 1993. The reclassifications have affected only a small portion of the open range area within the Cariboo Forest Region and the updated open range and forest areas differs very little from Option 5.

Options 7 and 8 (TEM - based - 1990 to 1995 and 1990's Aerial Photography - 1993 to 1997) would severely reduce abilities to meet grazing and biodiversity targets established by the CCLUP but would provide an small increase in the area of productive forest. The area of forest under these options would include recent encroachment and thus exceed the area assumed by the CCLUP. Information to describe these benchmark areas is not currently available and would require additional mapping and surveys.

Table 6. Evaluation of grassland benchmark area options. Each option is rated on a scale relative to other options in terms of how well it satisfies the particular criterion. Relative ratings are "++" (very favorable), "+" (moderately favorable), "=" (relatively neutral), "-" (moderately unfavorable), and "--" (very unfavorable).

Option	Critera						Comments
	1. Quality of information	2. CCLUP targets			3. Suitable for application	4. Existing information	
		Grazing	Biodiversity	Timber			
1. Pre-settlement	--	++	++	-	--	--	Suitability limited by poor information on which to assess and apply benchmark area
2. Early settlement	--	++	++	-	--	--	Suitability limited by poor information on which to assess and apply benchmark area
3. Post early encroachment	--	+	+	-	--	--	Suitability limited by poor information on which to assess and apply benchmark area
4. Early aerial photography	-	+	+	-	--	-	Suitability limited by poor information on which to assess and apply benchmark area
5. First available, complete forest inventory	++	=	=	=	++	++	Considered most suitable option; grassland area very closely approximates area assumed by CCLUP; readily applied and date relatively consistent across region
6. 1994 forest inventory	++	-	-	=	++	++	grassland area consistent with area assumed by CCLUP but slightly decreases ability to meet range and biodiversity targets; readily applied but benchmark date varies widely (1962 - 1990) across region
7. TEM based	+	--	--	+	+	-	likely unable to meet AUM targets due to diminished grassland area (see Section 5); high risks to biodiversity; would require additional TEM projects
8. 1990's aerial photos	+	--	--	+	+	--	likely unable to meet AUM targets due to diminished grassland area (see Section 5); high risks to biodiversity; would require extensive additional inventories.

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4.3.2 Tree Cover Objectives for Benchmark Area

A principal goal of grassland restoration for the benchmark area is to return tree cover on the benchmark area to the condition that it likely had prior to European settlement. Implementation of this goal will require an understanding of the effects which frequent (10 - 20 year return interval) fires would have on density, size, and distribution of trees on these grasslands. Practices should be developed to mimic the effects of these frequent fires.

It is not recommended that the benchmark grassland area be managed throughout its distribution as a treeless grassland. Where present, scattered trees are an important component of grassland ecosystems and should be maintained in densities and distributions as they probably existed prior to European settlement. In some cases, the canopy cover of trees on benchmark grasslands should approach 15% over a polygon as-a-whole and higher values in small (<0.5 ha), localized stands of trees within the polygon. In general, this means that large, old trees and snags should be left standing while most smaller trees and regeneration should be removed. Small stands of large trees should be maintained but generally thinned by removing most smaller trees and stems in the regeneration layers. Sufficient smaller trees should be left to replace stands or isolated stems of large, old trees as they die and fall. Most lodgepole pine stems should be removed from the benchmark grassland area.

In order to achieve tree cover objectives for the benchmark area, silviculture obligations should not be attached to timber harvesting approvals. The principal goal of tree harvesting and removal should be restoration of open or sparsely treed grassland.

Any harvesting of trees must minimize long-term damage to grassland vegetation and soils. Any tracked or wheeled harvesting equipment operating on the grasslands should only be driven on frozen ground.

Implementation of tree cover objectives for the grassland benchmark area may present some timber harvesting opportunities as well as opportunities for other products such as chips and posts.

Table 7. summarizes tree removal recommendations for different age and size categories of trees within the grassland benchmark area.

Table 7. Tree clearing and harvesting recommendations for achieving grassland restoration goals on the benchmark grassland area

Tree Age/Size/Density Category	Description	Recommendations
Recent encroachment and ingrowth	• generally comprises the largest number of small trees on areas currently mapped as open range • Stems mostly established in early 1980's and currently 15 - 18 years old; • range in height from less than a meter when overtopped to more than 4 m when open grown • densities often high, frequently > 20,000 stems/ha • within stands, occur mostly under canopy gaps	• remove all stems with fire, cutting, or other means; • minimize mechanical disturbance of grassland vegetation and soils in order to conserve grassland ecosystems and discourage further establishment of trees; • removal of these stems is recommended as the highest priority for grassland restoration within the grassland benchmark area; • due to the apparently episodic nature of encroachment, only infrequent treatment may be required to control young encroachment.
Widely spaced (> 4 m) older encroachment	• very open (<15% canopy cover) stands or widely scattered trees, mostly 3 - 10 m tall, lack of abundant younger stems suggests that these stands may persist in very open condition • trees mostly established on grasslands between 1900 and 1965; currently 35 to 85 years old • locally common, especially on dry slopes and at low elevations.	<u>In the BG Biogeoclimatic Zone:</u> maintain at least 50% of the current density of widely spaced stems as wildlife habitat unless evidence indicates that they are leading to a stand with >15% canopy closure in the near future. <u>In the IDF Biogeoclimatic Zone:</u> remove at least 95% of current density of stems; 5% or less of largest stems should be retained for future large wildlife trees.

Moderately to very closed stands of older encroachment and in-growth	• forest stands which have resulted largely from encroachment and in-growth initiated 35 - 85 years ago, stands very often include isolated or small groups of large trees more than 140 years old (veterans);
	• a wide range of tree ages and sizes often present;
	• small (<1 ha) stands may have been present at the time of 1963-1975 inventory classification but were not mapped due to their small size;
	• larger stands have often resulted from coalescence of smaller stands due to recent encroachment or in-growth
		• Retain 90% or more of large veteran trees (generally >140 years old)
		• Maintain a small number of stems for future large trees:
		  • non-veteran stems > 12.5 cm dbh - if present, maintain three to four times as many stems as the total number of veteran trees.
		  • stems <12.5 cm dbh - retain about 10 times as many stems as the total number of veteran trees, preferably in a clumped distribution
		• Harvest or remove remaining stems.
		• Minimize mechanical disturbance of grassland vegetation and soils.

Isolated large old trees	• isolated individual or small groups of large trees, generally more than 140 years old.	• Retain isolated individual or small groups of large veteran trees as wildlife habitat

5.0 Implications of Recommended Benchmark Option.

5.1 Forage Production and AUM Allocation

5.1.1 Background to Implications Assessment

The Cariboo-Chilcotin Land-Use Plan (CCLUP) commits government to "maintain and enhance existing Animal Unit Months (A.U.M.s)". For each polygon delineated in the CCLUP there is a stated A.U.M. commitment level. The polygons cover large areas. Within these large polygons are stock ranges which are separated into range units. The range unit is the operational management unit for managing livestock use; within a unit, there may be one or more areas separated by physical barriers to create pastures. All A.U.M allocations in grazing tenures are at the range unit level or lower.

The CCLUP polygons do not follow range unit boundaries. The conflicting boundaries make it impossible to calculate the exact A.U.M. level of use within the polygons. To derive the A.U.M. figures for the CCLUP, estimates were made where the polygon boundaries cut across range units. The CCLUP dealt with this problem by stating that A.U.M.s will be maintained at existing levels and distributions. This statement ensures that the volume of forage available for grazing is maintained in essentially the same distribution pattern across the landscape as it was at CCLUP initiation.

5.1.2 History

Cattle arrived in the Cariboo-Chilcotin with the gold rush. Open Douglas-fir forest with nutritious bluebunch wheatgrass understories were interspersed with expanses of vigorous perennial grasslands. Early cattlemen utilized the Cariboo-Chilcotin grasslands year round. Cattle were left on rangelands to rustle through winter for feed. As herds grew in size, the grasslands were damaged. Overgrazing occurred throughout the Cariboo-Chilcotin during this period of unrestricted use prior to about 1930.

The grasslands became less productive due to reduced plant vigour, weed invasion, and early forest ingrowth and encroachment. Perennial grasses and forbs were replaced with annual grasses and weeds. With the loss of plant litter and roots to protect the soil, topsoil was blown off grassland slopes and gullies formed when soil was washed away.

The B.C. Forest Service range management program began in response to this situation. The beginnings of a management infrastructure began in the 1930's with fencing and allocation of forage. By the 1960's the fencing infrastructure necessary to systematically graze livestock was largely in place and livestock numbers were established. Overall levels of use were reduced and were tracked by tenure permits. The permits established dates of use, cattle numbers, and locations of use. The new drift fences provided the means to control cattle grazing and grasslands now had time to grow, rest, and recover. During the ensuing 30 years the program was fine tuned by adding fences, building stock trails and water developments, and making minor adjustments to livestock numbers and dates of use.

The essential range management principle is to leave half (50%) of the available forage after grazing. This guarantees litter to protect the soil from erosion and desiccation, and leaves plants with enough vigour to produce seeds for replacement of dead plants. Leaving half ungrazed also ensures recovery on depleted rangelands. For example, when the reduced stocking levels were set for Bald Mountain in the 1960's, it was at the current production on a depleted rangeland. Once the stocking levels were adjusted to leave half the available forage after grazing, the plants began to recover and production actually increased for a short period. For awhile the carryover of ungrazed forage exceeded 50%. Theoretically this increasing trend in forage production would have continued except the negative effects of forest ingrowth and encroachment were also increasing. Gradually the balance between production and utilization shifted. Even though the livestock numbers were essentially unchanged, carryover of ungrazed forage was less than half because there now was less land producing livestock forage. By the mid 1990's carryover of ungrazed forage was negligible and it was obvious range condition was deteriorating. This is shown in Figure 8 Forage Production Changes Over Historical Time. By the late 1990's stocking had been reduced on Bald Mountain by over fifty percent to reflect diminished forage production resulting from a smaller forage land base.

When stocking levels were established in the 1960's, the grasslands were larger and the forests were more open than today. Many of the turn of the century Douglas-fir forests were parklike with grassy vegetation beneath widely spaced trees or small groups of trees. These grassy understories contained many of the same species as the adjacent grasslands. Most sites were dominated by nutritious bluebunch wheatgrass and contributed substantial amounts of forage. These open forests had diminished by the 1960's but were more common than they are today.

Most of these open stands have disappeared with forest ingrowth. The grassland understories have been shaded out and replaced with more shade tolerant pinegrass understories. With extreme shading, even the pinegrass has disappeared and all that remains is moss and needle litter.

Figure 8. Forage Production Changes Over Historical Time

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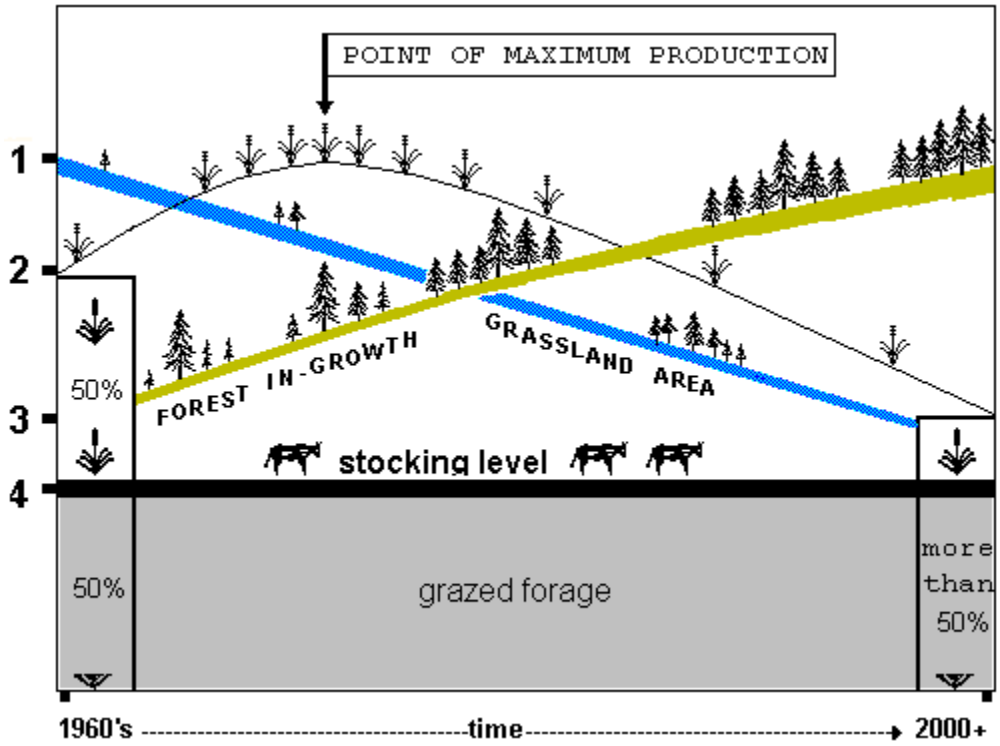

The "Forage Production Changes Over Historical Time" chart shows the combined effects of four inter related functions. They are grassland encroachment, forest ingrowth, range recovery, and stocking levels. Each line is explained below:

1. Line of diminishing grassland area over time due to encoachment. This line shows with the progression of time, the number of trees increase. This produces a smaller grassland area represented by a progressively thinner downward line indicating a decrease in forage volume.
2. Line of rangeland recovery with 1960's reduced stocking levels. This line shows that the plants were in poor vigour when the stocking rate was reduced to leave 50% of the current growth after grazing. For a brief period, the rangelands began to recover. Plant vigour improved resulting in bigger more productive plants. Annual weeds and grasses were replaced with more productive perennial grasses and forbs. However, as time progresses the grasslands become smaller, the result of encroachment. The forests produce less forage due to ingrowth. With less forage, the remaining grasslands are grazed more heavily and plants begin to loose vigour. Less than 50% carryover remains after grazing.
3. Line of increasing canopy cover from forest in-growth over time. This line shows that at the beginning there were big openings between the trees that supported grass. Over time, the trees keep increasing in size and the open spaces formerly growing forage are reduced.
4. Line of forage carryover and forage utilization at the 1960's stocking rate over time. This line shows in the 1960's a set number of cattle were put on the range. At that date, the amount of encroachment and ingrowth are shown on the left side of the chart. The new reduced stocking rate grazed 50% of the forage as shown by the grey area under the cattle. The remaining 50% of the forage was left ungrazed as shown in the vertical box on the left side. Moving to the right the amount of forage being grazed remains constant because cattle numbers have not been changed. However, the amount of forage left after grazing, as shown in the vertical box to the right, is considerably less than 50%. This is because the amount of forage being produced has dropped since the 1960's. The drop in production is due to diminished forage production in the forest, tree encroachment replacing grass, and a downward trend in plant vigour from increased grazing pressure by the same number of animals on a smaller grassland base.

5.1.3 Forage From Timber Harvesting

Reduced forage production from diminished grassland and open forest area has been partially offset by timber harvesting. After logging, increased light levels support increased forage growth. This has been important in some areas in offsetting the impacts from encroachment and in-growth.

However, partial timber harvesting, common in Douglas-fir forests adjacent to the grasslands, removes several of the larger trees but often does not adequately thin the young, smaller stems. As a result, forage production increases only slightly and grassland species do not return.

Comaparison Of Forage From Grasslands And Forests

The quantity and quality of forage produced after harvesting on forested sites versus forage produced on grasslands is different. Cattle also utilize the two different types differently which influences ranch management costs. Weight gains and successful breeding are the key elements to ranch profits. These key elements occur while cattle are on Crown range.

The location and size of grasslands determines how they are managed. Most of the larger grasslands have been fenced separate from the forest. Smaller grasslands, because of fencing costs, are usually included in forested pastures. The large fenced grasslands are grazed in the early spring and sometimes in the late fall. The grasslands in the forested sites, which tend to be small and scattered, are usually grazed during the summer. The major differences between grazing on the grasslands and in the forest are:

1. A hectare of grassland in good condition produces more forage than an equivalent harvested forest area. Many forested sites produce little or no livestock forage until harvested. Most harvested forested sites reach maximum forage production three to four years after logging. Within seven years forest regeneration begins to reduce forage production. The useful grazing period on a cut block is around twenty years. It takes more hectares of logging to produce the same amount of feed.

A cow with calf on a forested site has to work harder the obtain the same amount of feed. This may mean a cow, which has wintered poorly, will not regain weight quickly after calving and consequently produces less milk. Calves with good milking mothers gain more weight per day.

She may also miss her rebreeding cycle. Fit cows recycle early which means the ranch continues to produce early calves with heavier fall sale weights. Cows that recycle late have to be sold for slaughter, as they can not regain the missed cycle the following year. Maintaining early cycles is critical to ranch profits.

2. Cattle are more scattered on forested sites. Cattle graze on forested sites differently than on grassland areas. Because there is less forage per given area, cattle have to travel over a larger area to get the same amount of feed. They also tend to be distributed in smaller groups than those grazing on grasslands. Normally where cows are closely bunched the number of bulls needed is less than one for every twenty cows. When cattle are in smaller groups, however, it is necessary to have more bulls to get the same coverage. Substituting a cow for another bull nets the ranch one less calf to sell.

3. Season of use is earlier on grasslands. Most turnout dates for cattle grazing on Crown Range in the BG zone are between March 15th through April 15th; turnouts on private grasslands may be even earlier. Most turnout dates on the IDF upper grasslands are by May 15th. Forested pinegrass ranges are normally not ready for grazing until June 1st or later. For a ranch, early turnouts mean a shorter winter feeding period. This shorter period allows a ranch with early range to have a larger herd than a ranch with equivalent hay production and a later turnout. More calves enhance ranch profits.

4. Forage quality is different. Cutblocks typically contain mostly pinegrass, several small forest sedges, kinnikinnick and twinflower, and a dozen or so forbs. Rose, willow, buffalo berry, juniper, and alder, are common shrubs that may be present. Pinegrass is the dominant forage grazed by cattle along with two or three forbs. Reported protein levels for pinegrass are equivalent to most grassland grasses in June. Pinegrass however, is rated low in palatability for cattle throughout its growth period. Cattle do not like to eat pinegrass. By August lignin has significantly increased and palatability for cattle is poor. As the available energy from pinegrass drops, cattle concentrate on grazing rose, willows and small poplar saplings.

Grasslands typically contain a more diverse mix of grass species and forbs. Bluebunch wheatgrass and several different needle grasses are usually found in Cariboo grasslands. There are several common bluegrasses, junegrass, a number of dryland sedges, and numerous forbs. Because both bluegrass and upper grassland needle grasses remain green thoughout the summer and fall, their value is high. This mix of plants maturing at different times offers a range of plants with higher available energy than pinegrass.

5. Management costs are typically lower on grasslands. Cattle are easy to find on grasslands. Injured or sick cattle can be seen easier and therefore treated. Bulls are easier to find and moved to areas where there are more cows to be bred. Most ranches using the grasslands have their ranch headquarters in the grasslands. In the fall, the cattle naturally drift from their summer forested grazing areas back onto the Crown grasslands where they are more easily found, rounded up, and taken home. These fall grassland ranges also reduce the cost and time cattle have to be fed hay.

Other Limitations

Range tenures are area based volume tenures. When one range unit produces less forage, using another unit with increased forage production due to recent logging is usually not an option. First, there is probably already a forage shortfall in a unit that has been recently logged. Second, the affected ranch must have prior tenure to graze in the unit with the new forage. Third, the forage must be accessible. New forage several kilometers from the ranch headquarters is often not usable if it is not within easy travelling distance for a cow and calf.

Additional limitations to substituting forage from cutblocks results from livestock use patterns. Ranches with significant elevation changes begin their grazing season at lower elevations. Cattle move in set patterns and are dependent on having forage available with each move to a higher elevation pasture. The lowland ranges, where grasslands rather than forests dominate the landscape, are extremely valuable and cannot be replaced by forage at higher elevations on logged sites.

5.1.4 Forage Distribution With-in A Unit

Within any grazing unit, there is a mosaic of ecological types. The relative proportion of grassland and forest is just one component. The pattern of the mosaic will influence how cattle use an area. For example, cattle will make more use of forest forage if the grasslands are small and evenly distributed throughout the forest. In this case, stocking levels will have been based primarily on the forest forage component especially if the total grassland area is small. Cattle will congregate in the openings and will continuously move looking for more feed in the next patch of grassland. While travelling from one site to the next, they will graze in the forest or in the cut blocks.

Conversely forests adjacent to large grasslands will be grazed less. Past stocking rates will have been weighted on managing the grassland component. For the rancher, large grasslands are desirable and can be managed separately if fenced from larger forested areas. Cattle are easier to find, look after, and move. A single cowboy can distribute cows off a large grassland area whereas keeping them off numerous smaller grasslands is an impossible task. During breeding cows are concentrated with the bulls and are bred on their first cycle. In addition, less bulls are needed because cattle are not scattered across the whole range unit.

In some range units the proportion of grassland to forest is small while in others it is high. Stocking levels set in the 1960's were based on:

- the ratio of grassland to forest.
- the amount of grassland.
- the amount of forage produced within the forest.
- the distribution of grassland within the forest.

The following chart (Figure 9) shows the proportion of open range to the total area of the range unit from Lone Cabin Creek along the west side of the Fraser River to Big Creek on the south side of the Chilcotin River. Riparian areas are included with the forest. The data was extracted from the 1983 Range Resource Analysis report; it does not include private land with Range Unit boundaries. It is important to note that these data are based primarily on forest inventory classifications conducted in the 1960's and early 1970's.

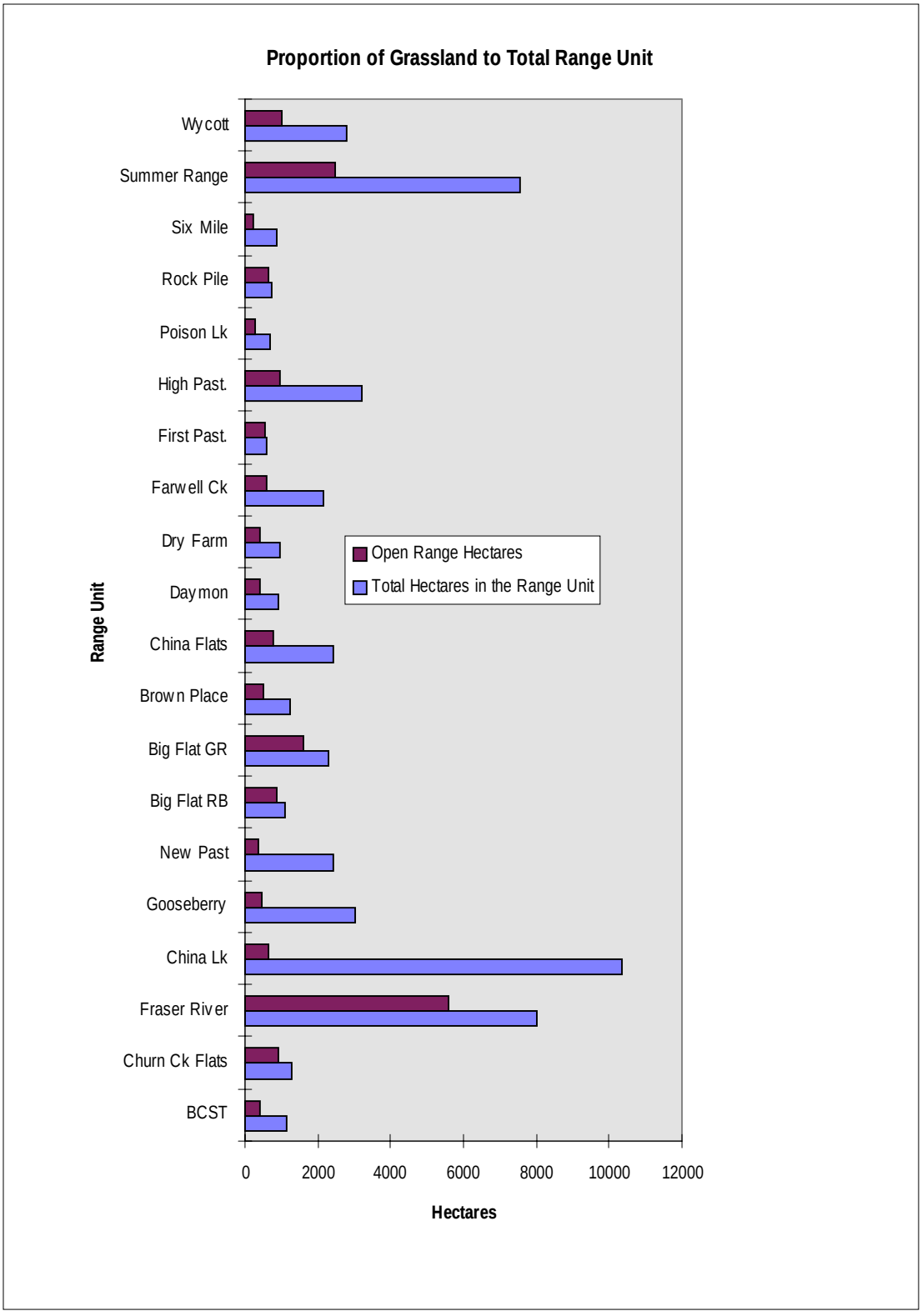

Figure 9. Proportion of Grassland to Total Range Unit

5.1.5 Short Term Range Impacts

The A.U.M commitments in the CCLUP can be maintained in most areas for five or more years without a concerted effort to control encroachment and ingrowth. However, the goal of maintaining a 50% forage carryover and achieving biodiversity seral stage targets cannot be achieved.

Cattle use will continue to concentrate in the remaining open grassland and riparian areas. Impacts to riparian areas will continue to increase due to losses of open forest and grassland forage. The loss of forage through encroachment and ingrowth will be largely unnoticed until plant vigour and composition dramatically decline in the open range and riparian sites.

5.1.6 Long Term Range Impacts

Reductions in A.U.M.'s will be unavoidable if in-growth and encroachment continue unabated. In the absence of A.U.M. reductions, the previous history of overgrazed grasslands, weeds, and widespread soil erosion will be repeated.

The grassland recovery initiated by livestock stocking levels set in the 1960's was dependent on forage production from both the forest and grassland. Recovery of the grassland area to the 1960's to early 1970's level (recommended grassland benchmark option; Section 4.3) addresses one component of the problem. Increased production of quality forage from the forest will be needed for grasslands to continue to move towards CCLUP and Forest Practices Code seral stage targets.

AUM committments should be attainable within biodiversity targets if both the recommended grassland benchmark option is implemented and production of forage in open forests is addressed.

Figure 10 illustrates landscape change over time. The restoration depiction shows a balance between grassland and timber production that would have existed in the 1960's when most stocking levels were established.

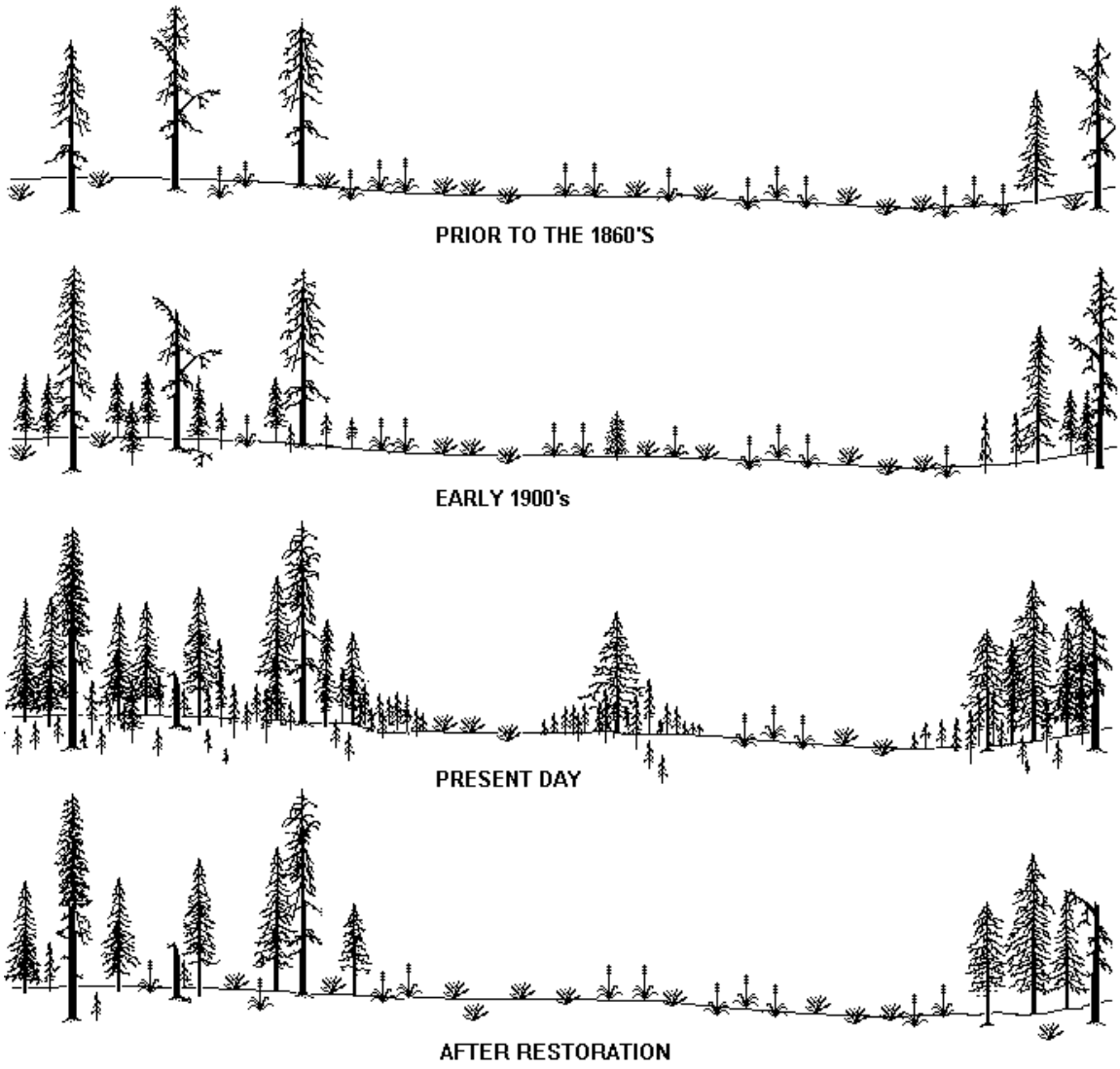

Figure 10. Diagramatic representation of typical tree cover changes resulting from enroachment and ingrowth and grassland restoration.

5.1.7 Short Term Ranch Impacts

There will be few short term impacts on ranch economics if no concerted effort is made to control encroachment and in-growth. Change in range condition always proceeds change in livestock condition. Cattle will have acceptable weight gains in the short term while range forage production declines.

5.1.8 Long Term Ranch Impacts

The long term implication for ranch economics is dire if no efforts are made to control encroachment and in-growth. As encroachment and in-growth continues, the quantity and quality of forage will diminish. Production costs will increase as cattle will have to travel farther to obtain the same amount of forage. Ultimately livestock numbers will have to be reduced to the level of available forage. Ranch amortization schedules based on cattle numbers maximized to hay base production will be upset. Some operations may find they are over capitalized.

There will be costs associated with the program that will have to be assumed by the ranching industry. However, those costs will be partially offset by maintenance and or enhancement of A.U.M. committments in the Cariboo-Chilcotin Land-Use Plan.

5.2 Biodiversity

Encroachment and in-growth on the grasslands has apparently been occurring in pulses over the last century. The implications to biodiversity are not quantified over that time period but are likely highly significant. The recommended benchmark represents a recovery of some part of that lost grassland. Estimates from areas that have been assessed support a loss of about 30% of the grassland area between the early 1960s and now. Although management to the benchmark would not represent full recovery of grassland biodiversity, it would be very significant. As described previously, the maintenance of AUMs on a diminishing grassland creates the ancillary problem of habitat damage in specific parts of the grassland. Recovery of grassland is therefore expected to contribute to biodiversity conservation in terms of both increased grassland area and improved grassland seral condition.

Acceptance of the benchmark provides the potential for achieving grassland objectives as outlined in the CCLUP, specifically:

- management of critical habitat through the FPC and Riparian and Biodiversity guidelines including the designation of Sensitive Areas or Wildlife Habitat Areas. Safeguarding riparian habitats is of particular importance.
- maintenance of climax seral communities targets as defined by the Biodiversity Guidelines Specific Targets (by landscape unit) are: 12% climax seral state, 85% near climax.

Progress towards these objectives will require prompt attention to restoration treatments for removing unwanted tree cover and good management of livestock using crown lands.

Management of grasslands to the benchmark, as compared with current situation represents a reduction in the risk to biodiversity. That risk is not directly quantifiable but clearly an increase in functioning grassland area of 11% and improvement of grassland condition, will reduce the likelihood of losing individual species and losing key habitats. Recovery of seral condition will be especially significant to those red and blue listed species that have life requisites associated with older seral grass communities.

This significantly reduced risk to biodiversity is estimated to result in a relatively small reduction in timber supply. Among the Open Range (OR) polygons that were re-inventoried, the rate of forest encroachment is considered to be quite low, due to specific ecological factors. The result is that about 1100 ha of OR is now deemed to have become treed as compared with the inventory the benchmark is based upon.

The ability to accurately assess risk to biodiversity is extremely difficult both because of the ecological complexity and the lack of inventory done in grasslands. That is why the CCLUP also included specific recommendations as follows:

- (p158) continuation of present research and inventory programs to further identify species and habitats of concern. Management of these habitats should consider all resource values.
- (p161 under Research and Inventory) areas which should receive immediate attention are:
- grassland habitats and the grassland complex of species at risk.

Future assessment of risk will only be improved through the implementation of these recommendations.

The recommended benchmark does not provide for loss of grassland due to in-growth. Treatment of in-growth in forested polygons to recover a grassy understory will also contribute substantively to biodiversity. This topic will be addressed more thoroughly in the final grasslands strategy.

The rate of recovery of grassland to benchmark levels is a function of several factors including current condition, effectiveness and timing of treatment and management of other habitat influences such as livestock distribution. Some damaged grasslands take decades before reaching a climax condition. Others

will certainly take less, especially where the encroachment or grazing pressure has not created profound changes in the habitat condition. Many riparian areas recover very quickly once protective measures are applied.

In summary, the risks associated with maintenance of grassland biodiversity are significantly reduced with adoption of the benchmark. This is accomplished through the maintenance of open grassland habitat, comparable to that which existed in the 1960s and early 70s, and reduced cattle grazing impacts. However, the recommended grassland benchmark area does not include significant areas of forest encroachment which occurred prior to 1960 and, as a result, represents a smaller grassland area than existed naturally prior to European settlement. Some grassland biodiversity has likely been lost as a result of this early encroachment.

The open forest which existed adjacent to the grasslands prior to European settlement were an important habitat for many species. It is essential that the open canopy and grassy understory of these forests be at least partially restored in order to maintain grassland biodiversity over the long term.

Improvements in habitat quality will occur at different rates but due to the time required to bring some ecosystems closer to climax condition, it is imperative that treatments be applied promptly. Species associated with late seral grasslands are likely to benefit most from a recovery program.

Hooper and Pitt (1995) suggest that “old growth” grasslands are already significantly scarcer than old growth forests in B.C. due to the relative scarcity of grasslands as a whole combined with land alienation and the historical use. Despite a long history of use and associated degradation, grasslands in the Cariboo-Chilcotin represent the best opportunity in B.C. to recover biodiversity due to the lower levels of development and human population relative to other comparable grassland ecosystems in the province (Hooper and Pitt 1995).

5.3 Timber

5.3.1 Effects on CCLUP forest area

Background

Implementation of the recommended grassland benchmark area would reduce the area managed for timber compared to the area contained in the 1994 forest inventory, which was used to develop the Cariboo-Chilcotin Land Use Plan (CCLUP). Reductions will result from reversing the increase in area of forest in the inventory that occurred between the date of the proposed grassland benchmark (1963-1975) and 1994. This increase resulted from forest inventory updates, which extended forest polygons into open range polygons, and reclassifications, which reflected forest encroachment and ingrowth since the previous classification. Forest inventory updates occurred where new harvest blocks and infrastructure were developed along the boundary between forest and open range polygons. For example, where a timber harvest block extended into an open range polygon to harvest a few trees, the area of the forest inventory polygon was expanded into the open range polygon to include the harvest block. Forest inventory updates altered only those polygons specifically affected by the timber harvesting or infrastructure development.

Inventory reclassifications potentially altered all polygons within an inventory map sheet as a result of reclassifying the entire map sheet area from interpretations of current aerial photographs. New forest encroachment and in-growth, which occurred between the date of the 1963 - 1975 inventory classification and the reclassification, would, where sufficiently extensive, be reflected in an expansion of forest inventory polygons into areas previously classified as open range.

Most map sheets with extensive open range have been affected to some degree by inventory updates and resulting small increases in productive forest area. However, inventory reclassifications have been completed for only about 25% of the current open range in the Cariboo Forest Region. Nearly 75% of the open range in the Region occurs on map sheets that were not reclassified after 1975. On these map sheets, which cover most of the grassland area, the recommended grassland benchmark would affect the CCLUP forest area only as a result of inventory updates between 1963-1975 and 1994.

Approach

The approach used to estimate the effects of the proposed benchmark on productive forest area was to compare 'open range' and productive forest areas in the earliest available inventory data base (.SEG files) with their areas in the current inventory data base (.FIP files). At the time of this report, the 1963-1975 inventories are not available in a GIS compatible format for overlay and map-based calculations of differences. The approach relies on a comparison of total areas by map sheet.

The objective of this comparison was to determine the amount of decrease in area of 'open range' and corresponding increase in the area of productive forest between the earliest available database and the current inventory database. It was considered that a decrease in area of 'open range' and corresponding increase in area of product forest might be due to forest encroachment between the two dates.

This analysis uses the current inventory database (2000) rather than an inventory data base current at the time of the CCLUP (1994), due to logistic difficulties in retrieving the 1994 data base. There have been no inventory reclassifications of map sheets between 1994 and 2000 and, as a result, the current inventory would differ from the 1994 inventory due only to inventory updates. The resulting over-estimation of the effects of the recommended grassland benchmark area is expected to be very small, especially in the context of other assumptions that may affect the analysis.

The earliest available inventory database is the oldest version (version 1) of the .SEG files in the ODM files. This oldest version of the database was developed from digitizing of hard copy forest inventory maps in the late 1980's. The maps that were digitized had apparently not, in all cases, been updated to reflect most recent cutblocks prior to being digitized and would show an inventory quite similar to the inventory of 1963 – 1975. Other maps, that were updated prior to digitizing may reflect some decrease in the area of open range compared to the 1963-1975 inventory but the extent of this decrease is anticipated to be small.

Not all inventory map sheets in the Cariboo Forest Region were used in the assessment of impacts of the benchmark grassland on productive forest area. A preliminary comparison of the earliest and current inventory databases for some map sheets indicated very large changes, either positive or negative, in the area of open range. For example, the area of open range on map sheet 93C035 increased from 11 ha to 908 ha between the earliest and the current database while the area of open range on map sheet 93C085 decreased from 912 ha to 0 ha. Other similar large changes are common for map sheets in the 93C letter block near the Itcha-Ilgachuz Mountains. A comparison of forest inventory maps from the two dates indicated that these large changes have resulted primarily from interpreter differences in the classification of wetlands, meadows, and open range. The large increases or decreases of open range on these map sheets do not reflect changes in the area of forest and non-forest vegetation resulting from encroachment. As a result, all map sheets within letter block 93C having numbers larger than 030 were excluded from the analysis.

A second group of map sheets that were not included in the analysis were those north of the Itcha-Ilgachuz Mountains and eastward along the boundary with the Prince George Forest Region, including all map sheets in letter blocks 93F, 93G, and 93H. In addition, all 93B map sheets with numbers greater than 60 (except for 93B068), were not included. There is no or extremely little open range on these map sheets although there are significant areas of wetlands and meadows. These map sheets were excluded to avoid interpreter differences in the classification of wetlands, meadows, and open range. Since there is so little open range on these map sheets, conclusions regarding regional timber impacts would be little affected by excluding these sheets.

Additional map sheets that were not included are those contained entirely within Parks. These are primarily within Tsy-los Park but also include two map sheets (92O015 and 92O025) in Big Creek and 1 map sheet (92I091) in Marble Range Park. These map sheets were excluded from this timber impact analysis since parks are not within the timber harvesting land base. Map sheets that were partly inside and partly outside the boundary of a park were included in the analysis. Thus all map sheets in Churn Creek Protected Area and Junction Sheep Range Park were included.

372 map sheets were included in the analysis. In the current inventory, these map sheets include 210,889 ha of open range. The excluded map sheets include 13,094 ha of open range that occurs primarily in the Itcha and Ilgachuz Mountains, the area immediately south of these mountains, and on Itcha Flats south of Itcha

Lake. Outside of letter blocks 93C and 93F, the excluded map sheets (in 93B, 93A, 93G, and 93H) currently include only 447 ha of open range.

The assessment of differences did not distinguish between crown and private land.

In order to estimate the amount of forest area in the current inventory that would be affected by implementing the recommended grassland benchmark, the following approach was used:

- Step 1: Determine the reduction in area of open range area between earliest available inventory and current inventory for each map sheet; if open range has increased, assume zero change for purposes of this analysis.
- Step 2: Determine the increase in area of productive forest between earliest available inventory and current inventory for each map sheet.
- Step 3: Estimate the impacts of the proposed benchmark on forest area as the lesser of the absolute value of the decrease in area of open range and increase area of open forest; i.e. the impact is assumed to measured by a decrease in area of open range matched by an increase in the area of forest.

Results

Using the above approach, the estimated reduction in area of productive forest resulting from implementing the recommended grassland benchmark is 3,261 ha. Since the reduction includes all areas within Churn Creek Protected Area and Junction Sheep Range Park, as well as all private lands, it probably greatly over-estimates the impact to productive forest area within the timber harvesting land base. It is likely that the impact to forest area within the timber harvesting land base would be considerably less than 2,446 ha (75% of the assessed value) or 0.07% of the total forest area in the Cariboo-Chilcotin.

The total area mapped as open range in the inventory data has actually increased by just over 2,400 ha from the earliest available inventory to the current inventory. This increase is likely due to classifier interpretation differences resulting in areas previously classified as meadows or wetlands being reclassified as open range. One result of using the initial inventory as the grassland benchmark is that areas currently classified as open range will not be included in the grasslands benchmark area if they were classified as meadow or wetland on the initial inventory. On the other hand, many areas currently mapped as meadows in the Itcha-Ilgachuz area would be included in the benchmark since they were initially mapped as open range. Forest encroachment of these areas is expected to be very minor since they are usually in cold, moist basins.

The total area of productive forest within the included map sheets has increased by 2,056 ha between the earliest available and the current inventory data bases. That is, if timber impacts of the proposed benchmark were measured only by changes in the area of productive forest without requirement for a corresponding decrease in open range, the estimated impacts would decrease by about 1,200 ha.

If all map sheets within the region are included in the analysis, the forest area impact as assessed by the above approach is 9,964 ha, a three-fold increase. This is inconsistent with the relatively small amount of open range within the excluded map sheets and observations from this area suggesting that forest encroachment has affected a very small area. As described above, the map sheets included in the analysis contain 210,889 ha of open range while the excluded map sheets contain only 13,094 ha. The larger impacts when all map sheets are included, likely result from inventory classifier differences regarding interpretation of open range and other non-productive types.

5.3.2 Impacts to potential long-term forest area

If no action is taken to control encroachment, the total area of forest in the Cariboo Forest Region will continue to increase as the area of grassland decreases. Implementation of the grassland benchmark would limit this increase. Although few data are available to assess long term potential encroachment, the potential rate can be assumed similar to shorter term estimates of the rate of encroachment.

Estimated percent and total area of encroachment for biogeoclimatic subzones in the Cariboo Forest Region are included in Table 3 in Section 2. Estimated values are for encroachment that has occurred during the time period since 1965 when the initial forest inventory classifications in the region were being done. That

is, they are estimated values for the last 35 years. If the rate of encroachment remains constant for the next 85 years, then the total area of encroachment at the end of the 120 years following 1965 will be approximately four times the total area of encroachment given in Table 3 or 85,896 ha. Although this would represent a 39% reduction in the area of open range within the region since 1965, it would be less than a 1.5% increase in the area of forest.

The long-term rate of encroachment may differ from the short-term estimates. The rate would likely decrease over time in the Bunchgrass Zone as the area that can potentially support tree growth is approached. In the Interior Douglas-fir Zone, however, the rate of encroachment may increase for a time as large expanses of grassland become broken up by islands of trees. These islands may function as epicenters of encroachment. Eventually, the rate of encroachment would slow as the sites most capable of supporting trees become forested.

The newly established forest area resulting from encroachment would not all support merchantable timber at the end of 120 years. Approximately half of this area would have trees less than 80 years old. In addition, the quality of most of the timber would be low due to the abundant low branches typical of trees that have established on grassland. Timber quality could be improved by pruning after canopy closure is achieved. Alternatively, the next generation of stems, established beneath the encroachment and released by mortality of the encroachment would generally have superior timber quality.

5.3.3 Forest Stand Management Outside the benchmark Area.

As introduced in Section 3,the strategy for managing encroachment and in-growth recommended in this report includes stand structure management outside the benchmark area. Although stand structure guidelines have not been included in this interim report, the anticipated guidelines in the final report will likely include thinning to reduce canopy closure and to remove dense suppressed and intermediate stems. Implementation of these guidelines would return the stands to a structure more like that prior to European settlement and result in increased forage production.

6.0 Recommendations

6.1 Benchmark Area

Option 5 is the recommended benchmark area option. This option identifies the area to be managed for grassland as those polygons mapped as open range (OR) on the initial forest cover inventory maps for the Cariboo. These inventory maps date back as early as 1963. Clearly encroachment of grasslands occurred long before this date. Nevertheless, management to this benchmark would result in a significant recovery of grassland with little impact to timber supply. Correlation to the OR polygons also establishes a spatially based record for reference over time. The total area encompassed by this approach is approximately 215,000 ha., most of which exists as grassland or early seral forest at this time.

6.2 Timber Supply Analysis

The open range (OR) polygons used to identify the benchmark grassland area must be retained in the forest cover inventory as an intact layer for future timber supply analysis. Unless all encroachment were treated immediately, future re-inventory of forest would likely label some encroached OR polygons as treed. To avoid having these polygons falsely contribute to long-term timber supply the original inventory layer used to define the benchmark grassland area is needed to remove those polygons from future timber supply analyses.

6.3 Priority Areas for treatment

The priority BEC zones for treatment at this time are IDF and BG. Within those zones, Beecher Prairie, Bald Mountain and Word Creek have all been assessed with respect to encroachment and represent suitable candidates for treatment now. Following regional assessment, other areas may be identified as priorities for treatment.

Generally, ranking candidate areas for treatment requires discussion among MOF/MOE staff in Forest districts, local ranchers and forest licensees. Criteria pertaining to ranking are as follows:

- Significant value as grassland,
- Encroachment on the area is well documented,
- Area is accessible,
- Area is susceptible to further encroachment,
- Current timber impacts would be negligible or non-existent,
- Meaningful experimentation is possible.

6.4 Urgency of Treatment

Treatments should be implemented on priority sites as soon as possible to curtail the existing encroachment and provide opportunities to test and evaluate different approaches. There is some urgency to begin ecosystem restoration before the existing trees increase in size or another wave of encroachment worsens the situation. Treatment costs may well increase according to the size and density of the trees involved.

6.5 Treatment and Control of Encroachment

Removal of encroachment should focus primarily on young trees and stands greater than 1 ha. It is important to retain some forest cover on grasslands, especially veterans, recruitment trees and isolated clumps of mature trees.

Participation of both the forest industry and ranchers is essential to the implementation of a grasslands strategy, particularly the recovery of encroached areas. Where forest licensees treat OR polygons to remove encroachment, it is essential that they be relieved of normal silviculture obligations to restock the area.

Harvest opportunities

When new areas are accessed, roads could be planned along the forest grassland interface, thereby providing a firebreak to prevent prescribed burns from encroaching on the forest. This would permit safer use of summer burns necessary to recover grassland with advanced tree encroachment. Potential opportunities for harvesting timber and other forest products on the benchmark area needs to be assessed.

Incentives could also be established to encourage harvest or control of encroachment. Without specific incentives, products like fence posts, chips and Christmas trees could be utilized from young encroachment provided viable markets were available. Some older encroachment would be suitable for lumber production.

There is opportunity for ranchers to aid in control of encroachment on crown land as well. Incentives could involve reduced grazing fees or maintenance of AUM stocking levels. It is important that the encroachment areas are clearly delineated and the type of control method is acceptable. Some examples of possible control methods are as follows:

Fire: Many ranchers already burn their private lands each spring. With proper safeguards this activity could be undertaken routinely on identified crown grasslands.

Winter knockdown: Encroachment readily breaks off at ground level when frozen. Ranchers could be encouraged to use farm machinery to knock down encroachment on specific areas that are easily reached from ranch headquarters.

Herbicides and mechanical knockdown: With the possible assistance from government, individual trees could be treated with herbicide or mechanically removed using devices like the Kershaw Clearway. Combinations of treatments might be necessary to maximize effectiveness.

6.6 Responsibility for Implementation of Grasslands Objectives

Implementation of a grasslands recovery program will require ongoing attention to annual management activities including the selection and treatment of specific areas. Several agencies have significant interest in grassland management, however the Forest Service retains responsibility for range management and implementation is best carried out via the administrative structure at the District level.

6.7 Research and Inventory

Continued research and inventory of grassland ecosystems in the Cariboo/Chilcotin should be encouraged through identification of priority needs, development of partnerships (Universities, First Nations, government agencies, ranchers, forest companies and other) and solicitation of funding.

More work is required to understand the ecosystem processes in grasslands, the life requisites provided to specific organisms, mechanisms of forest encroachment, the role of fire and the consequences of different management activities. Further recommendations for research and inventory will be provided in the final grasslands report.

6.8 Landscape Unit objectives

The grasslands strategy is being prepared concurrently with landscape unit objectives derived through District based sub-regional plans. The opportunity therefore exists to include grassland objectives in the initial landscape unit package declared by District Managers. Although the Chief Forester has indicated that the identification of old growth management areas and wildlife tree objectives are priorities, he has also indicated that other objectives can be included as long as they do not delay the declaration of these two. Provided the grassland benchmark is accepted without lengthy delay after its completion in 2000, grassland objectives can easily be prepared in time for inclusion with the others.

6.9 Adaptive Management

In order to assess whether management approaches to grassland recovery and maintenance are both effective and efficient, it is important to monitor the outcome of treatments. Moreover, it is important that key questions be identified and treatments implemented to deliberately test specific hypotheses. This reflects an adaptive framework whereby research questions are addressed in a management framework that continually leads to improvement.

6.10 Non-crown grassland

Much of the grassland in the region and in the province is private property. Government has no direct control of these lands, but significant progress towards grassland objectives could be achieved if landowners were encouraged to recover and maintain grassland values on their own land. This would increase the total area managed for grassland and could relive some grazing pressure on the crown land portion, if AUMs are not increased. Government can be instrumental in establishing economic incentives to promote such action.

6.11 Communications

The importance and condition of our grasslands is not commonly understood. Government needs to raise the profile of grassland by promoting greater educational programs about grassland values and specifically the encroachment problem.

Within the Forest Service prescribed burning provides a logical training activity for fire crews. This would provide valuable experience in fire behavior, setting backfires and familiarization with equipment. Such burns can also provide valuable training and field experience for visiting students and other publics.

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APPENDIX 1 - GRASSLANDS STRATEGY WORKING GROUP
Terms of Reference

December 4, 1998

Background

The Grasslands Strategy Working Group has been initiated at the request of the Cariboo-Mid Coast Interagency Management Committee (IAMC) to develop a strategy for addressing principal grassland conservation issues. These issues are identified by the Cariboo-Chilcotin Land Use Plan (CCLUP), the IAMC, and the working group. Grasslands are identified under the CCLUP as an area for development of targets and strategies.

Purpose To develop and recommend to the IAMC and the Cariboo-Chilcotin Regional Resources Board (RRB) a strategy to ensure the sustainability of grassland habitats and species while maintaining grazing targets as identified by the CCLUP.

- Identify principal issues related to the sustainability of Cariboo-Chilcotin grassland habitats, species, and forage availability
- Identify and evaluate management options to address principal issues
- Ensure that stakeholder input, CCLUP direction, and other essential information is incorporated into the identification of issues and management options
- Identify preferred management option(s) for addressing principal issues
- Identify critical gaps in information and technology preventing the achievement of desired levels of management

Membership

Ministry of Agriculture and Food: 1 Agrologist member (chairman)
Ministry of Forests: 1 Range and 1 Research member
BC Environment: 1 Habitat Protection and 1 Endangered Species member
BC Parks: 1 member

Working Group Tasks

Phase I

1. Identify principal issues threatening the long-term sustainability of grassland biodiversity, wildlife habitats, species, and forage resources in the Cariboo-Chilcotin region. Identify the magnitude of issues in terms of risks to achieving FPC biodiversity targets, wildlife habitat conservation, and CCLUP grazing targets.
2. The initial priority of the working group will be to address high priority forest encroachment/ingrowth issues and management options, particularly with regard to interim guidelines for a grassland area benchmark.

Phase II

1. Identify management options for addressing all principal issues, including forest encroachment/ingrowth, in order to mitigate risks to biodiversity, wildlife habitat, and forage resources.
2. Evaluate management options, including an assessment of impacts of each option on biodiversity, wildlife habitat, grazing resource, timber harvesting, recreation, First Nations, and other values.
3. Select recommended management options.

4. Recommend inventories and management and research trials to fill critical gaps in information.
5. The working group may require funding and additional staff resources to complete its tasks. It will be responsible for identifying these needs and initiating requests for support.

Reporting

The working group will report directly to the IAMC.

Stakeholder Involvement

Stakeholder involvement will be through the RRB and REAC (Range Enhancement Advisory Committee). All reports will be provided to the RRB and REAC.

Products

1. Presentation on encroachment/ingrowth issues and a preliminary list of other issues to the RRB in December 1998.
2. Interim Grassland Area Benchmark report, providing interim recommendations for setting a benchmark grassland area and an interim evaluation of implications of recommended benchmark areas for forage, timber harvesting, and biodiversity values.
3. Progress updates provided to the IAMC, RRB, and REAC as requested.
4. Grassland Strategy Draft report presented to the IAMC and RRB. This report should describe all issues, management options, and recommendations for management and be submitted to the IAMC and RRB for review and approval.
5. Final Grassland Strategy report.

Schedule

A presentation to the RRB should be made as soon as possible.(December 1998) This presentation should describe the overall purpose and mandate of the working group and focus on a summary of forest encroachment and ingrowth issues.

Interim Grassland Area Benchmark report: June 1999.

Progress Reports: March 1999.

Grassland Strategy Draft report: May 2000.

Progress reports: September 1999, December 1999, March 2000.

Final Grassland Strategy report: June 2000

APPENDIX 2 - Cariboo Chilcotin Grasslands Strategy

Key Elements- DRAFT

A. Introduction

Impetus and Direction

CCLUP and IAMC(90-Day Implementation Report)
Forest Practices Code guidelines(Biodiversity, riparian, range management)

Objectives of strategy

Maintain area of grasslands
Maintain domestic range use targets
Maintain and enhance biodiversity including wildlife
Provide baseline information for future planning

B. Background

Definitions of grassland

Inventory
Ecological
Principal ecosystems

Distribution of grasslands in Cariboo - Chilcotin

Historical and current extent(Estimates)

Ownership of grasslands

Private and crown

Values of grasslands

Domestic range
Biodiversity and Wildlife
Recreation and aesthetics
First Nation

C. Historic and Recent Trends

Disturbance Trends

Natural (pre-settlement) disturbance trends in Cariboo-Chilcotin grasslands
Disturbance regime changes associated with European settlement
Historic and current range use practices(1800 to present)

Grassland community changes

Forest Encroachment and Ingress
Seral stage/condition
Wildlife habitat
Riparian condition
Introduction of non-native species
Cultivation

Implications on grassland values and uses

Domestic range use
Biodiversity and wildlife
Recreation and aesthetics
Other

D. Grassland Management - Issues

1. **Diminishing crown grassland area.**

Need and method for establishing a benchmark for grasslands land base.
Need for establishment of stand-level management guidelines.

2. Inability to meet Forest Practices Code.
Determination of potential natural community and desired plant community.
Ability to achieve seral stage objectives.
Application of guidelines in range use planning

3. Management of riparian areas in the grasslands.
Determination of proper functioning condition.
Determination of potential natural community and desired plant community.
Application of guidelines in range use planning.

4. Fire as a grassland management tool
Costs and benefits of prescribed fire for grassland management.

5. Non-native species in grasslands
Impacts and control of weeds and other species.

6. Conservation of listed/identified species
Maintenance and recovery of habitats for red/blue listed and featured species.

7. Conservation of rare and unique ecosystems
Maintenance and recovery of rare and unique ecosystems.

8. Meeting grazing targets.

Maintaining and enhancing forage quality and quantity.

9. Integration of grasslands strategy and landscape Unit Planning.
Inclusion of grasslands objectives in higher level landscape unit plans to to direct operational planning..

E. Recommendations

- Establish a technical committee (range, wildlife/biodiversity, parks, agriculture) and select a chairperson.
- Present outline and terms of reference to IAMC and RRB.
- Focus first on establishing grasslands benchmark by:
  a) Seeking resources to conduct an assessment.
  b) Identify research sites to experiment with selected treatments.
  c) develop a monitoring framework to assess grasslands recovery.
- Identify consequent priorities with respect to grassland management issues.

APPENDIX 3. Habitat of Red and Blue Listed Species Found in the Cariboo-Chilcotin Grasslands within the BGxh, BGxw, and IDFxm Biogeoclimatic Subzones.

Subzone occurrence information is from Hooper and Pitt (1995) and habitat information is adapted from Cannings et al. (1999) and Fraser et al. (1999).

Status refers to the Provincial red and blue listed wildlife species status.

'V1' under the Identified Wildlife column indicates species that have been designated as Identified Wildlife in the Identified Wildlife Management Strategy Volume 1.

Species	Status[1]	Subzones of occurrence	Identified Wildlife	Habitat Requirements
Great Basin Spadefoot toad	blue	BGxh, BGxw, IDFxm		Typically breed in shallow ponds within low to moderate elevation grasslands.
Painted Turtle	blue	BGxh, BGxw, IDFxm		**
Rubber Boa	blue	BGxh, BGxw, IDFxm	V1	Found in lower dryer habitats and require CWD.
Racer	blue	BGxh, BGxw, IDFxm	V1	Range restricted to grasslands.
Gopher Snake	blue	BGxh, BGxw, IDFxm	V1	Range restricted to grassland and shrub-steppe.
Swainson's Hawk	red	BGxh, BGxw, IDFxm		Use large tracts of open grasslands.
Ferruginous Hawk	red	BGxh, BGxw	V1	Forages over flat and rolling grasslands and open shrub-steppes. Nests in open stands of trees.
Peregrine Falcon	red	BGxh, BGxw, IDFxm		**
Prairie Falcon	red	BGxh, BGxw, IDFxm	V1	Require cliff or escarpments near open, dry sagebrush steppes or grasslands.
Sharp-tailed Grouse	blue	BGxh, BGxw, IDFxm		Breed in bunchgrass grasslands.
Sandhill Crane	blue	BGxh, BGxw, IDFxm	V1	Feeds in upland grasslands and ripaian/wetland habitats.
Upland Sandpiper	red	BGxh, IDFxm		Require undisturbed grasslands and old fields for breeding.
Long-billed Curlew	blue	BGxh, BGxw, IDFxm	V1	Nest in large tracts of open grasslands.
Barn Owl	blue	BGxh, BGxw, IDFxm		**
Short-eared Owl	blue	BGxh, BGxw, IDFxm		Nest in open treeless areas such as grasslands.
White-throated Swift	blue	BGxh, BGxw, IDFxm		Nest and forage on and near towering cliffs and canyons in the dry interior.
Lewis's Woodpecker	blue	BGxh, BGxw, IDFxm	V1	Nest in wildlife trees in the grasslands.
Yellow-breasted Chat	red	BGxh	V1	Range restricted to dense riparian thickets in dry, open habitats.
Brewer's Sparrow	red	BGxh, BGxw	V1	Breeds and feeds in sagebrush-steppe.

Species	Status[1]	Subzones of occurrence	IW[2]	Habitat Requirements
Grasshopper Sparrow	red	BGxh, BGxw, IDFxm	V1	Breed in dry, moderately open grasslands. Not occurring in early seral or heavily grazed areas.
Bobolink	blue	BGxh, BGxw, IDFxm	V1	Inhabits open areas, including hayfields, moist meadows.
Spotted Bat	blue	BGxh		Occur at low elevations in the dry Interior.
Western Small-footed Bat	blue	BGxh, BGxw		Occur at low elevations in the dry Interior.
Fringed Myotis	blue	BGxh		Roosts preferred in arid grasslands and woodlands.
Townsend's Big-eared Bat	blue	BGxh, BGxw, IDFxm		Restricted to lower elevations.
Badger	red	BGxh, BGxw, IDFxm		Inhabit bunchgrass grasslands.
California Bighorn Sheep	blue	BGxh, BGxw, IDFxm	V1	Forage in open grasslands.

Other red or blue listed species that depend on grasslands include the Sage Thrasher, Lark Sparrow, and Night Snake. These species may occur in the Cariboo-Chilcotin but have not yet been identified.

APPENDIX 4. B.C. Conservation Data Centre Rare Vascular Plant Tracking List (April 26, 1999)

This table contains species which occur in biogeoclimatic units of the Cariboo-Chilcotin with frequent grasslands (BGxw2, BGxh3, IDFxm, IDFdk3, or IDFdk4).

SCIENTIFIC NAME	COMMON NAME	BEC ZONE	GLOBAL RANK	PROVINCIAL RANK	PROVINCIAL LISTING
ALLIUM GEYERI VAR GEYERI	GEYER'S ONION	IDF	G4G5T4	S2	RED
APOCYNUM MEDIUM	WESTERN DOGBANE	BG IDF	G5?	S2S3	BLUE
APOCYNUM SIBIRICUM VAR SALIGNUM	CLASPING-LEAVED DOGBANE	BG IDF	G5?T?	S1?	BLUE
ARABIS HOLBOELLII VAR PINETORUM	HOLBOELL'S ROCKCRESS	IDF	G5T?	S1?	BLUE
ARABIS LIGNIFERA	WOODY-BRANCHED ROCKCRESS	BG IDF	G5	S2S3	BLUE
ARABIS SPARSIFLORA	SICKLE-POD ROCKCRESS	BG IDF	G5	S1	RED
ARNICA CHAMISSONIS SSP INCANA	MEADOW ARNICA	BG IDF	G5T?	S1?	BLUE
ATRIPLEX ARGENTEA SSP ARGENTEA	SILVERY ORACHE	BG IDF	G5T5	S1	RED
BOUTELOUA GRACILIS	BLUE GRAMA	BG IDF	G5	S1	RED
CAREX HELEONASTES	HUDSON BAY SEDGE	IDF	G4	S2S3	BLUE
CAREX HYSTERICINA	PORCUPINE SEDGE	BG IDF	G5	S1?	BLUE
CAREX SAXIMONTANA	ROCKY MOUNTAIN SEDGE	IDF	G5	S2S3	BLUE
CAREX SIMULATA	SHORT-BEAKED SEDGE	IDF	G5	S2S3	BLUE
CAREX XERANTICA	DRY-LAND SEDGE	BG IDF	G5	S2S3	BLUE
CASTILLEJA TENUIS	HAIRY OWL-CLOVER	BG IDF	G5	S1	RED
CHAMAERHODOS ERECTA SSP NUTTALLII	AMERICAN CHAMAERHODOS	BG IDF	G5T5	S2S3	BLUE
CHENOPODIUM ATROVIRENS	DARK LAMB'S-QUARTERS	IDF	G5	S1	RED
CHENOPODIUM DESICCATUM	NARROW-LEAVED GOOSEFOOT	IDF	G5	S2	RED
CREPIS ATRIBARBA SSP ATRIBARBA	SLENDER HAWKSBEARD	BG IDF	G5T5	S1	RED
CREPIS OCCIDENTALIS SSP PUMILA	WESTERN HAWKSBEARD	BG	G5T5	S1	RED
DRABA REPTANS	CAROLINA DRABA	BG	G5	S1	RED
EPILOBIUM CILIATUM SSP WATSONII	PURPLE-LEAVED WILLOWHERB	BG IDF	G5T?	S2S3	BLUE

SCIENTIFIC NAME	COMMON NAME	BEC ZONE	GLOBAL RANK	PROVINCIAL RANK	PROVINCIAL LISTING
EUPHORBIA SERPYLLIFOLIA	THYME-LEAVED SPURGE	BG IDF	G5	S2S3	BLUE
GALIUM MULTIFLORUM	SHRUBBY BEDSTRAW	?	G5	S1	RED
GLYCERIA PULCHELLA	SLENDER MANNAGRASS	BG IDF	G5	S2S3	BLUE
JUNCUS ALBESCENS	WHITISH RUSH	IDF	G5	S2S3	BLUE
JUNCUS REGELII	REGEL'S RUSH	BG	G5	S2S3	BLUE
MELICA SPECTABILIS	PURPLE ONIONGRASS	IDF	G5	S2S3	BLUE
MUHLENBERGIA GLOMERATA	MARSH MUHLY	BG IDF	G5	S2S3	BLUE
PELLAEA ATROPURPUREA	PURPLE CLIFF-BRAKE	BG IDF	G5	S1?	BLUE
PHLOX HOODII	HOOD'S PHLOX	BG	G5	S1?	BLUE
POA FENDLERIANA SSP FENDLERIANA	FENDLER BLUEGRASS	IDF	G5T5	S1	RED
POLEMONIUM CAERULEUM SSP AMYGDALINUM	TALL JACOB'S-LADDER	BG IDF	G?T?	S1?	BLUE
POTENTILLA NIVEA VAR PENTAPHYLLA	FIVE-LEAVED CINQUEFOIL	BG IDF	G5T4	S2S3	BLUE
PYROLA ELLIPTICA	WHITE WINTERGREEN	IDF	G5	S1?	BLUE
SALIX BOOTHII	BOOTH'S WILLOW	IDF	G5	S2S3	BLUE
SALIX SERISSIMA	AUTUMN WILLOW	IDF	G4	S2S3	BLUE
SCOLOCHLOA FESTUCACEA	SPRANGLE-TOP	BG IDF	G5	S2S3	BLUE
SILENE DRUMMONDII VAR DRUMMONDII	DRUMMOND'S CAMPION	BG IDF	G5T5	S1?	BLUE
STIPA SPARTEA	PORCUPINE-GRASS	BG IDF	G5	S1	

The following is the ranking method used by the B.C. Conservation Data Centre using the system developed by The Nature Conservancy. It is used in parts of Canada, all the U.S. states, and a number of
Latin American countries.
Global Rank: **G** = The global rank is based on the status of the element throughout its entire range. **T** = Designates a rank associated with a subspecies.
Provincial Rank: **S** = The provincial rank is based on the status of the element within British Columbia.
1 = Critically imperilled because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction.
2 = Imperilled because of rarity (typically 6-20 occurrences or few remaining individuals) or because of some factor(s) making it vulnerable to extirpation or extinction.
3 = Rare or uncommon (typically 21-100 occurrences); may be susceptible to large-scale disturbances; e.g. may have lost extensive peripheral populations.
4 = Frequent to common (greater than 100 occurrences); apparently secure but may have a restricted distribution; or there may be perceived future threats.
5 = Common to very common; demonstrable secure and essentially ineradicable under present conditions.