



**Forest  
Practices  
Board**

## **Restoring and Maintaining Rangelands in the East Kootenay**

---

*Special Report*

**FPB/SR/53**

November 2016

# Table of Contents

---

<b>Commentary</b> .....	<b>i</b>
<b>Executive Summary</b> .....	<b>ii</b>
<b>Introduction</b> .....	<b>1</b>
Purpose .....	1
<b>Background</b> .....	<b>1</b>
History of Rangeland Management in the East Kootenay .....	1
Past Board Investigations of East Kootenay Rangeland Issues .....	3
A Resource in High Demand .....	3
<b>Approach</b> .....	<b>5</b>
<b>Results and Discussion</b> .....	<b>5</b>
Effectiveness of Actions to Improve Rangeland Area .....	5
Effectiveness of Actions to Improve Rangeland Condition .....	10
Threats to Rangeland Condition .....	13
<b>Conclusion</b> .....	<b>16</b>
<b>Appendix A: 2015 Rangeland Condition Assessment</b> – <b>Summary of Methods and Results</b> .....	<b>18</b>

## Commentary

---

This report on grazing and rangeland management in the East Kootenay highlights challenges that are complex and difficult—challenges that will require time, financial commitments and long term co-operation by government, forestry and ranching industries, hunters and recreational users of these lands. In some cases, it may require compromise in land use.

This is the third Forest Practices Board report on rangeland management in the East Kootenay. The Board is pleased to see its past recommendations being implemented. Progress is being made but restoration can quickly be negated and rendered ineffective.

Given the findings of this report, it will be important to ensure that emerging threats such as disturbance by off-road recreational vehicles and invasive plant management are fully considered as restoration work proceeds. Overall, this report points to the need for continued monitoring of the effectiveness of rangeland restoration work and adaptations to achieve the desired outcomes. Although this report did not look at how other FRPA values are being affected by rangeland restoration efforts, the Board encourages consideration of the stewardship of all values on rangeland ecosystems in the East Kootenay.

# Executive Summary

---

The East Kootenay has a long and complex history of rangeland management. For decades, effort has gone into restoring and maintaining rangelands lost to forest encroachment and ingrowth, in order to restore grassland ecosystems and associated grazing opportunities for cattle and wild ungulates (elk, deer and bighorn sheep). Conflicts have been ongoing due to competition between cattle and elk for limited forage opportunities.

In 2008, a Forest Practices Board complaint investigation found that cattle and elk were over-grazing rangelands in the East Kootenay and the Board recommended that government reduce forage use. Government responded with actions to reduce grazing allocations for cattle and increase hunting pressure to manage elk populations. In addition, efforts have continued to restore areas of grassland and open forest lost to forest ingrowth and encroachment. In 2015, a follow-up investigation by the Board reported that, overall, government had accomplished its actions, but the report did not comment on their effectiveness.

This special report looks at whether the actions implemented by government and others in the East Kootenay are increasing the area and condition of rangelands and, hence, improving the sustainability of grazing by cattle and wild ungulates. To accomplish this, the Board used four information sources: interviews with individuals; reviews of technical reports; data and area analyses from the provincial ecosystem restoration program; and a selected sampling of 25 benchmark sites. Overall, our assessment indicates progress towards improved area and condition of rangelands, but there are challenges.

- A government analysis in 2015 indicates that the Rocky Mountain Trench Ecosystem Restoration Program is halfway towards its targets for removal of closed forest cover, midway through its 33-year program. At the same time, follow-up monitoring shows that only 37 percent of the areas treated meet tree density standards for grassland and open forest and further treatments are needed on the remainder. Significant progress is being made, but regular maintenance will be required over the long term to prevent restored areas returning to closed forest.
- In recent years, the Ecosystem Restoration Program has increased its reliance on commercial forestry to open up areas of closed forest and create rangelands. The Board encourages the application of best management practices for forestry in areas restored to rangelands to promote their sound condition.
- The Board's field assessment of rangeland condition at 25 benchmark sites shows that the condition of most sites inventoried (76 percent) was unchanged or improved from a baseline assessment done 20 years ago and 72 percent of sites were in Good to Excellent condition at the time of the 2015 assessment compared to 60 percent at baseline. While this is a cautiously positive result, rangeland condition had declined on one-quarter of the sites, primarily due to damage from off-road recreation activities and the spread of invasive plant species.

This report concludes that, while progress is being made to increase the area and condition of rangelands in the East Kootenay, a number of issues threaten this progress and the sustainability of rangelands over the longer term. These threats include:

- ongoing encroachment and ingrowth of forests into restored rangelands;
- spread of invasive plants, including a rapid and unpredicted increase in the spread of species that were previously considered to be of lower risk;
- site disturbance due to industrial activities and off-road recreational vehicles;
- localized examples of poor grazing practices (e.g., poor timing of turn-out and rotations); and
- localized over-grazing by elk.

The BC Government is demonstrating leadership in its management of East Kootenay rangelands. Government staff are aware of, and actively working to address rangeland issues in collaboration with a dedicated group of stakeholders. Climate change will require continuous adaptation of management plans.

# Introduction

---

The East Kootenay has a long history of conflict over use of low elevation rangelands. More than a century of management policies to prevent and suppress forest fires has resulted in the conversion of rangelands to dense forests. As the area and quality of available forage has diminished, the competition for forage between cattle and wild ungulates, particularly elk, has increased.

Since the 1980s, government and a variety of non-governmental organizations have invested large amounts of time and money to study, plan for and restore rangeland ecosystems by opening up areas of dense forest, and further treating these areas to create grassland and open forest. More recently, government has also introduced programs to decrease grazing pressure in low elevation rangelands by reducing the numbers of cattle and elk.

## Purpose

The purpose of this project is to evaluate whether the actions taken by government and others, in response to the Board's 2008 report and recommendations, are improving the area and condition of rangelands in the East Kootenay, as it relates to the supply of forage to support grazing.

# Background

---

## History of Rangeland Management in the East Kootenay

The East Kootenay has wrestled with rangeland management issues for over 60 years. The distribution of vegetation in the area was historically maintained through frequent, low intensity fire events, including a long-standing use of fire by First Nations to promote grassland resources. In the early 1900s, a series of major wildfires triggered by logging, mining, and the railway created large expanses of rangeland, leading to increased grazing by livestock and wild ungulates (primarily Rocky Mountain elk and mule deer).<sup>i</sup> Suppression of wildfires began in the 1930s, and, over time, rangelands were replaced by dense forest cover that provided little in the way of forage. As the area and condition of available forage diminished, conflicts increased between ranching and wildlife interests. Associated problems included loss of critical habitats for wildlife species, a hazardous build-up of forest fuels, and increased incidence of forest insects, diseases and invasive species. By the 1980s, there were dozens of studies, reports and proposals to address issues related to rangeland use and management.<sup>ii</sup>

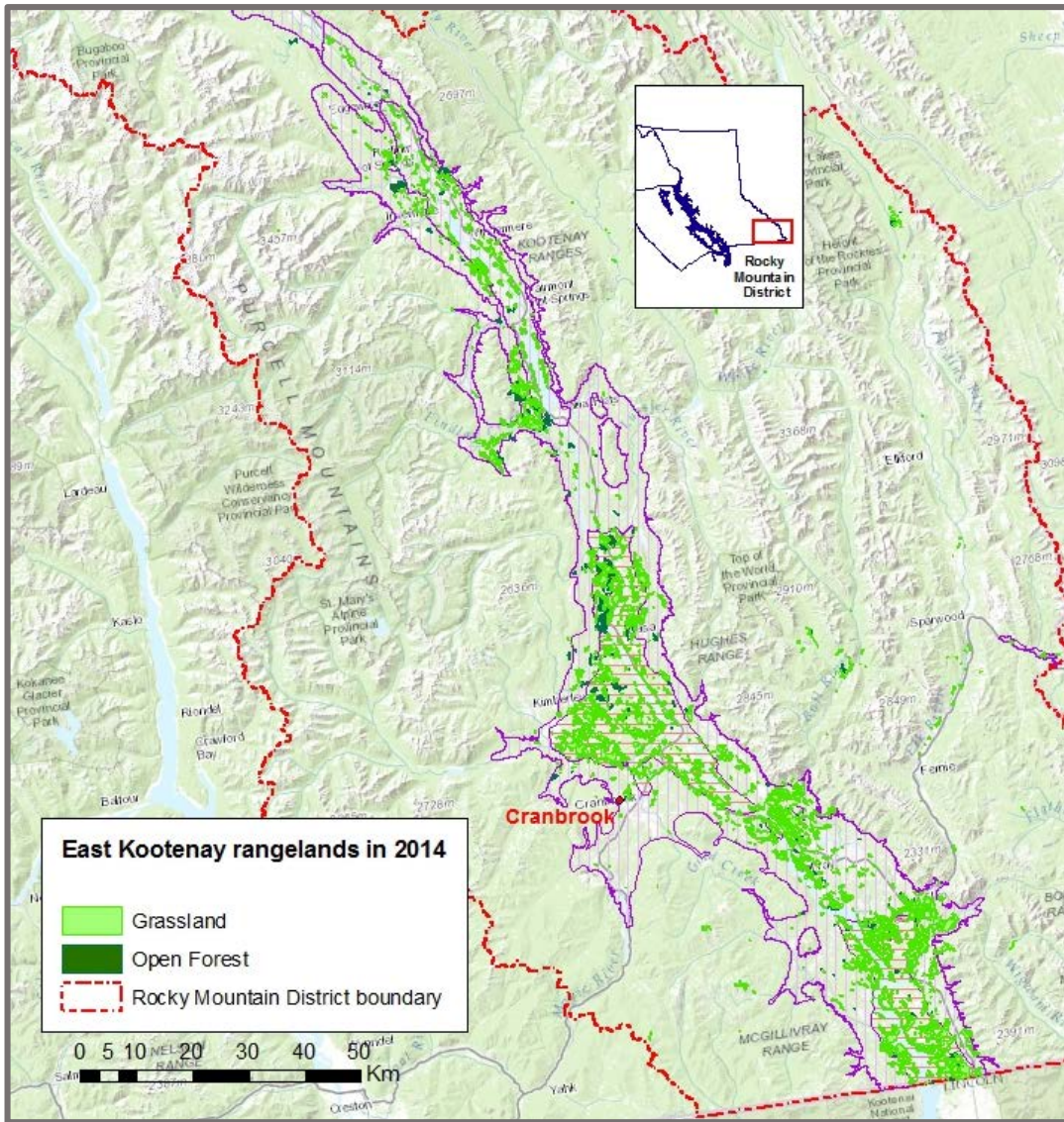
Collaborative planning began in the 1990s to address land use conflicts and plan for restoration of grassland and open-forest ecosystems.<sup>1</sup> The East Kootenay Trench Agriculture/Wildlife Committee was established in 1990 with representation from local stakeholder groups. The committee conducted studies and developed a set of objectives and recommendations to collaboratively restore and manage rangelands for wildlife, livestock, timber, recreational and ecological interests. This led to the establishment of the Rocky Mountain Trench Ecosystem Restoration Program (the ER Program), a

---

<sup>1</sup> Rocky Mountain Trench Plan (1990); East Kootenay Land Use Plan (1995); Kootenay Boundary Land Use Plan Implementation Strategy (1997).

partnership of 24 government and non-government organizations and First Nations bands with the mandate to restore grassland and open forest ecosystems in the Trench.<sup>2</sup>

The collaborative management of rangeland resources in the East Kootenay has strengthened over the years. In addition to the ER Program steering committee, a Range Strategic Team with representatives from agencies managing habitat, range, wildlife and ecosystem restoration, has met regularly since 2011 to discuss joint management of the range resource and ways to promote range health. This multi-stakeholder approach to ecosystem restoration has been emulated in other areas of BC in recognition of the benefits of bringing all players together to share expert knowledge, research and on-the-ground experience, and to expand opportunities for funding.



**Figure 1.** Map of grassland and open forest ecosystems in the Rocky Mountain District in 2014. (Source: Grasslands Conservation Council)

<sup>2</sup> A key player in the ER Program is the Rocky Mountain Trench Natural Resources Society (the Trench Society). The Trench Society is a coalition of ranching, hunting, environmental and wildlife organizations whose mandate is to restore and conserve grasslands and open forests.

## Past Board Investigations of East Kootenay Rangeland Issues

In 2008, the Forest Practices Board received a complaint that Crown rangelands in the East Kootenay were declining due to a combination of forest in-growth and increasing numbers of wild ungulates (Rocky Mountain elk, mule and white-tailed deer) on areas also grazed by cattle. The complainant took the view that this had resulted in lost ranching opportunity and over-grazed wildlife winter ranges.

The Board investigation<sup>iii</sup> found that grazing levels exceeded carrying capacity—East Kootenay rangelands were over-used and on a declining trend. The report noted that there was likely enough ecosystem restoration occurring to overcome loss of grassland habitats, but only if the condition of grassland ecosystems was also maintained. The Board recommended that government direct reductions in forage use in the East Kootenay “to levels sufficient to achieve a positive and continuing trend in grassland ecosystem condition.”

In 2011, the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) responded with a letter to the Board outlining the actions government had taken to address the recommendation in the 2008 report. These actions included efforts to decrease livestock grazing through reduced allocations of animal unit months on range tenures, targets to reduce the Southern Trench elk population, and ongoing ecosystem restoration activities to help restore and enhance forage production. Government also committed to continuing to take a “moderate, progressive approach to improving rangeland health in the East Kootenay in a manner that does not adversely impact this region’s ranching sector and hunting community.”<sup>iv</sup> The Board responded that it would continue to observe the situation, looking for a demonstrated improvement in grassland ecosystem condition.

In July 2015, the Board published a follow-up report<sup>v</sup> that showed, overall, that government has implemented the actions described in its 2011 response letter, but the report did not speak to the trend in grassland ecosystem condition or the effectiveness of the restoration program and actions taken by government.

## A Resource in High Demand

The East Kootenay rangelands are an example of the complexities of managing a land base with multiple values and uses, many of which overlap. Because the area of rangeland is limited, it is a balancing act to manage all of these values and land uses while maintaining a sustainable supply of forage for domestic and wild ungulates and other species. Put simply, there are many users and many mouths to feed on a limited land base.

### Rangeland values

**Ungulate winter range** – Grasslands and open forest habitats in the East Kootenay provide ungulate winter range for elk, white-tailed and mule deer, and big-horned sheep. Elk and cattle are the species that mainly compete for forage on grasses. Cattle also overlap with sheep and deer forage, but sheep winter habitats are small and very localized and, unlike cattle, deer mainly forage on shrubs and trees.<sup>vi</sup> Suitable winter range habitats require open areas for foraging adjacent to treed areas for security and thermal cover and, in the case of mountain sheep, escape terrain.



**Habitat for species at risk** – Rangelands in the East Kootenay provide critical habitat for a number of at-risk animal species, including Rocky Mountain bighorn sheep, American badger, long-billed curlew, Lewis’s woodpecker, Columbia sharp-tailed grouse and many at-risk plants and invertebrates.

**Biodiversity** – A number of red- and blue-listed plant species and communities are associated with rangelands, including some that have only been recorded in the East Kootenay (e.g., elk thistle and the antelope brush/bluebunch wheatgrass ecosystem). Periodic fire is integral to maintaining the overall health (composition, structure and function) of many of these rangeland ecosystems, which contribute to the diversity of ecosystems and habitats of BC.

### **Rangeland uses and activities**

**First Nations cultural use** – First Nations people traditionally used fire to maintain healthy grasslands and open forests in the Rocky Mountain Trench. They continue to use grasslands and open forests for cultural and economic purposes, and for harvesting traditional foods and medicinal plants. Archaeological sites are common in grassland areas as well.

**Grazing cattle** – The Range Program in FLNRO allocates and administers tenures for grazing and hay cutting on Crown land. In 2014, there were 107 range tenures and 37 468 authorized animal unit months (AUMs)<sup>3</sup> for cattle grazing in the Rocky Mountain Natural Resource District. As shown in the 2015 Board report, the number of AUMs is on a declining trend, down from 48 141 AUMs in 2005.

**Forestry** – Logging of trees for sawlogs and pulp occurs in the dry ecosystems of the East Kootenay when market conditions are favourable. The 2005 allowable annual cut (AAC) determination recognizes that restoration of fire maintained ecosystems in natural disturbance type (NDT) 4 is a priority. In the timber supply review, managed forests in the NDT4 that are logged to create grasslands or “open range” are removed from the timber harvesting land base, and stands managed for open forest are assumed to periodically have low volumes taken out to restore to, and then maintain, historic low densities. There is a partition to the AAC allocation for harvest in marginal stands outside of the timber harvesting land base (THLB) to promote ecosystem restoration treatments.

**Hunting** – FLNRO manages hunting intensity to achieve population objectives for hunted species. Regulations for elk provided for an increased harvest of antlerless elk (females and calves) in some management units under the 2010 – 2014 Elk Management Plan, in order to reduce crop damage on private land and relieve grazing pressure on forage supply. This measure was aimed at non-migratory homesteader elk that graze at low elevations in the spring and summer and impact winter

People often use the terms “rangeland” and “grassland” interchangeably, but they have slightly different meanings.

The following definitions are used in this report:

**Rangeland:** Land supporting indigenous vegetation that either is grazed or that has the potential to be grazed, and is managed as a natural ecosystem. Range includes grassland, grazeable forestland (open forest), shrubland and pastureland.

**Grassland:** Land on which the vegetation is dominated by grasses, grass like plants, and/or forbs. Grassland is a subset of rangeland.

<sup>3</sup> Under the BC *Range Act*, an animal unit month means 450 kilograms of forage, which is the amount of forage to sustain an average cow with an unweaned calf born for one month. Under current policy, the size of an ‘average cow’ is 1000 pounds, however, in practice, adjustments are made to account for increases in the size of livestock in recent years.

forage supply. Since 2014, the number of elk hunting licences has been reduced, but monitoring shows that elk populations are continuing to decline slightly (FLNRO, unpublished data).

**Recreation** – Level and accessible terrain in the East Kootenay makes the area popular for all-terrain vehicle use and dirt biking, including large numbers of recreationalists from out-of-province.

## Approach

---

This report is an investigation of the effectiveness of actions by government and others to restore and maintain rangelands in the East Kootenay region. The goal of this work was to evaluate whether or not government is achieving the desired outcome sought by the Board in its 2008 recommendation (i.e., to reduce forage use and achieve a “positive and continuing trend in grassland ecosystem condition”). In this report, we assume “a positive and continuing trend in grassland ecosystem condition” to be both the area of rangeland created through restoration treatments and progress toward preferred composition of plant communities, as identified through rangeland condition assessment.

In order to carry out this evaluation, the Board used four sources of information:

- Interviews with individuals involved with management of range and ranching, forestry, wildlife, hunting, outdoor recreation, invasive plant species, and environment.
- Reviews of technical reports on restoration, management and monitoring of rangeland health and condition, provincially and specific to the East Kootenay.
- Data and area analyses from the provincial ecosystem restoration program.
- A selected sampling of 25 benchmark sites to assess changes in rangeland condition over time. Assessment methods and results are summarized in Appendix A.

## Results and Discussion

---

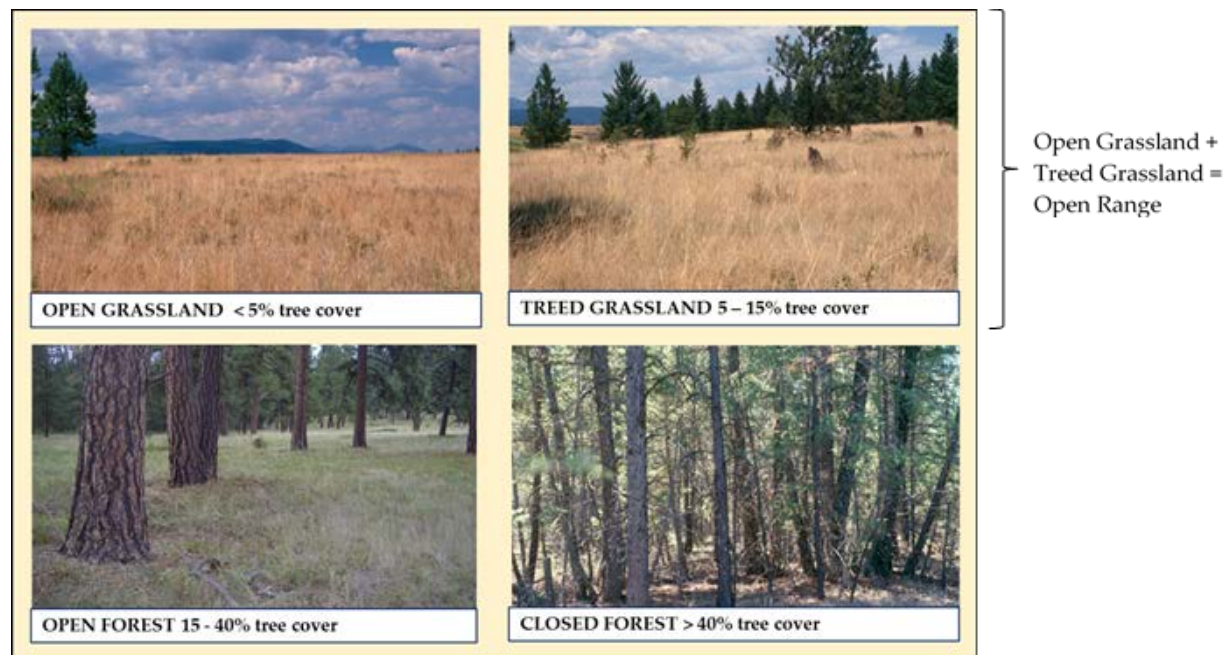
### Effectiveness of Actions to Improve Rangeland Area

#### Assessment of change in rangeland area

Rangelands in the East Kootenay mainly occur in NDT4, the natural disturbance regime in which frequent, low-intensity fires create “fire-maintained ecosystems” in a mosaic of grasslands, shrubland and forested communities. Approximately 14 percent of the Rocky Mountain Natural Resource District (417 792 hectares) is NDT4 and just over half of this, or 9 percent of the district, is Crown land. If fires are suppressed, grassland and open forest may be subject to forest encroachment and ingrowth, eventually transitioning to dense, closed forest. Rates of rangeland loss will vary depending on the site and weather conditions.

A considerable amount of rangeland has been lost to forest ingrowth and encroachment in the East Kootenay over the last century. Approximately half of the rangelands documented in the 1950s had grown into closed forest by the time the ER Program began its work in 1997. As rangelands transitioned into closed forests, cattle and elk became more concentrated in reduced foraging areas

that became increasingly over-grazed and damaged. Large areas of high value rangeland have also been lost to urban development (e.g., housing, golf courses, resorts), transportation and linear corridors, and agricultural conversion, further concentrating areas available for grazing by livestock and wildlife.



**Figure 2.** Ecosystem categories in the NDT4, based on amount of tree cover (Source: Rocky Mountain Trench Ecosystem Restoration Program).

Since 1997, the ER Program has undertaken yearly activities such as logging, burning, slashing and spacing to remove or thin closed forest cover and restore rangelands. This work represents the collaborative efforts of provincial natural resource agencies, the Ktunaxa Nation, forest and range industry representatives and a range of non-government stakeholder groups, with support from over 30 program funders.<sup>4</sup> The current targets for the ER Program (set in 2000 and updated in 2006 and 2013) are to restore 109 000 hectares of closed forest to grassland and open forest by 2030 and maintain this into perpetuity.<sup>5</sup>

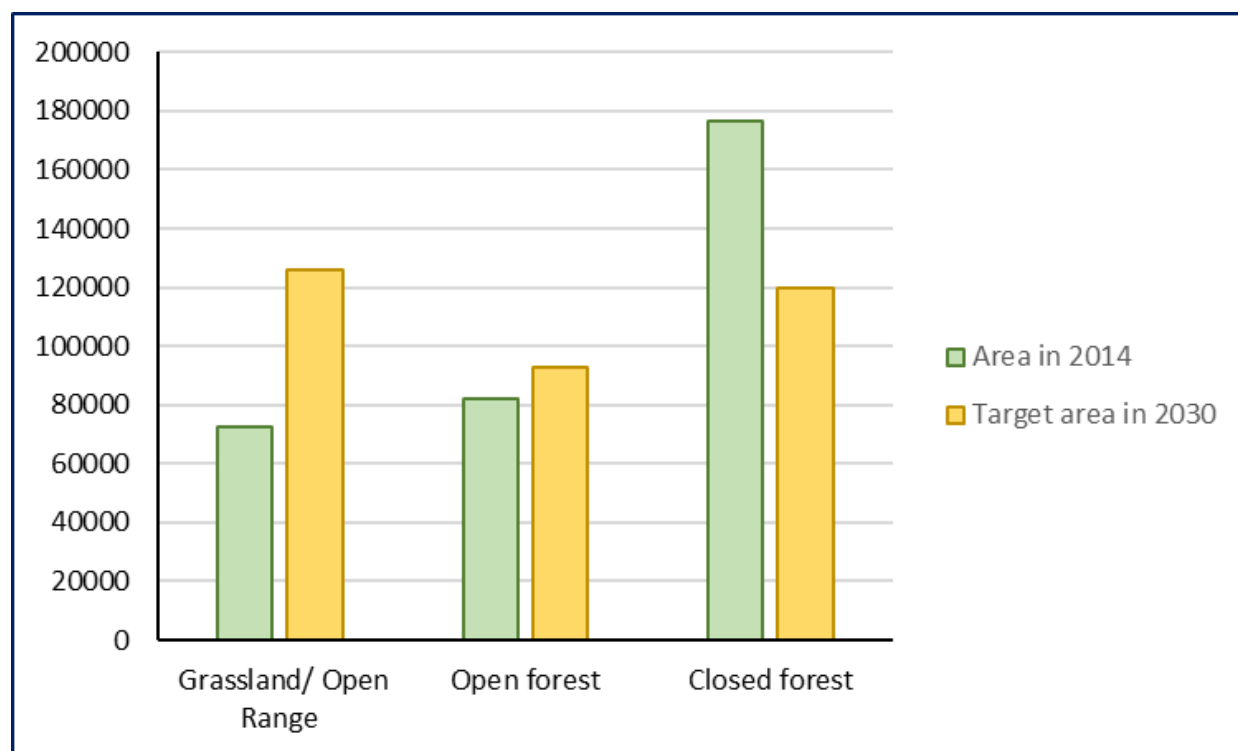
In 2015, the FLNRO Range Program undertook an analysis of spatial data to compare the current distribution of fire-maintained ecosystem components (open grassland, treed grassland, open forest, closed forest) in the NDT4 to the desired future distribution.<sup>vii,6</sup> The analysis summarized the total area of all fire-maintained ecosystems in the East Kootenay, within and outside of areas identified for

<sup>4</sup> Reported most recently in the 2013 Blueprint for Action - [http://trencher.com/images/uploads/Blueprint2013\\_booklet\\_web.pdf](http://trencher.com/images/uploads/Blueprint2013_booklet_web.pdf)

<sup>5</sup> As stated on the UWR Order U-4-006, the stocking standard for Open Range is 5 - 75 trees/hectare which must include 5 - 20 trees of the largest 1/3 of the existing diameter range and the stocking standard for Open Forest is 76 - 400 trees/hectare which must include 20 - 50 trees of the largest 1/3 of existing diameter range.

<sup>6</sup> The desired future distribution of fire-maintained ecosystem components was an estimate of the potential of sites to restore to grassland or open forest and was derived using an algorithm that combines vegetation and forest cover data on leading tree species, aspect and site index. The algorithm was originally developed in the East Kootenay based on traits identified in the field and was adapted to other parts of the province.

restoration. Based on this work, the desired future distribution in the East Kootenay is 125 937 hectares of grassland/open range and 92 776 hectares of open forest (218 713 hectares total), including provincial, federal, and private lands and Indian Reserves. The distribution in 2014, halfway into the ER Program’s 33-year plan, was 72 701 hectares of grassland/open range and 82 272 hectares of open forest (154 973 hectares total), with 176 270 hectares of closed or managed forest (Figure 3).

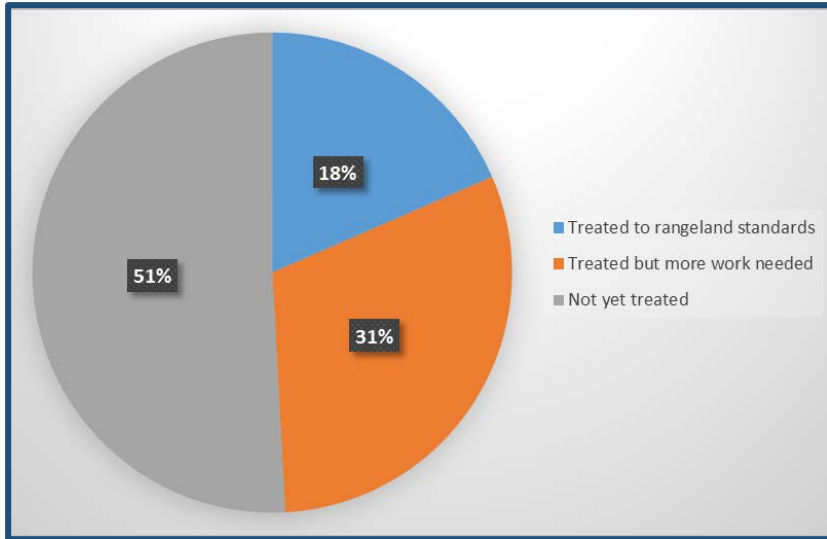


**Figure 3.** Estimated distribution of NDT4 ecosystem components in 2014 in the East Kootenay compared to the desired future distribution. Numbers include federal and provincial lands, private land and Indian Reserves. (Source: BC Range Branch)

While these results suggest significant progress towards the desired area of grassland and open forest, they do not account for the condition of areas restored. Without ongoing maintenance, areas opened up to rangelands will regenerate back to forest that is unavailable for grazing.

Maintenance is expensive and challenging to implement over the large areas treated under the ER Program. Treatments need to occur frequently enough (i.e., every 7 to 10 years) to effectively keep tree regeneration from occurring.

Ecosystem restoration tracking data shows that, as of 2015, only 20 135 hectares (37 percent) of the 53 551 hectares of area treated to date met the standards for grassland and open forest, in terms of the number of stems per hectare. For the remaining 33 416 hectares, trees had been removed but some form of additional treatment (e.g., prescribed burning, slashing, mastication) was needed to complete the restoration process or to remove tree seedlings regenerating into older treatment areas. Half of the targeted area of restoration had yet to be treated to meet the ER Program target of 109 000 hectares (Figure 4).



**Figure 4.** Status of restoration areas treated 1997 – 2015. As of June 2016, the restoration target for the Rocky Mountain Trench Ecosystem Restoration Program was 109 000 hectares. (Source: Provincial Ecosystem Restoration Program)

The partners in the ER Program have acknowledged that their goal of maintaining 109 000 hectares of grassland and open forest in perpetuity is likely unattainable and they will revisit their restoration targets in 2016. A new delivery model is planned in which areas of closed forest in the NDT4 are opened up over time through commercial logging, while the ER Program focuses on maintaining core areas of grassland and open forest. Areas that are not maintained will provide grazing in the short term but will grow back into closed forest and eventually be re-opened through logging. The ER Program is working collaboratively with other partners to achieve its maintenance goals while minimizing costs.

The reintroduction of fire through prescribed burning is the preferred technique for maintaining the grasslands and open forests characteristic of fire-maintained ecosystems. These ecosystems benefit from the use of fire to curb tree regeneration, restore native grasses, herbs and shrubs, and input nutrients to the soil. The ER Program has partnered with the Southeast Fire Centre of the BC Wildfire Service to conduct prescribed burns in restoration areas in the spring to train the centre’s firefighters and create fire breaks.

Some forest types are more likely to regenerate quickly to dense seedlings that reduce grazing potential (e.g., in Interior Douglas-fir ecosystems). Restoration treatments that target areas that are likely to remain as grassland or open forest will be more cost-effective over the long term, as they will require less maintenance.



**Figure 5.** Ecosystem restoration site between Cranbrook and Kimberley in 2016, one month after winter logging on frozen ground. (Photo: Susan Bond)

## Site-level forestry practices to restore rangelands

As described in the previous section, commercial logging is a key part of the new delivery model for rangeland ecosystem restoration. Commercial logging is a cost- and resource-efficient approach to restoring rangelands that also provides jobs and economic benefits to local communities.

Logging is the first step in the restoration process; removing an overstorey of timber to release grassland vegetation. Care must be taken at this stage to minimize disturbance and promote the healthy recovery of native grasses and shrubs. In 2014, the ER Program published a set of best management practices in response to concerns that forestry activities in restoration treatment units were creating a high level of soil disturbance, reducing the effectiveness of forage production, and increasing the risk of invasive plant establishment.<sup>viii</sup> Key recommendations are to log on frozen ground or snowpack to minimize site disturbance and to promptly re-seed disturbed ground, using the current ecosystem restoration seed mix, in order to prevent establishment of invasive plants.

Under FRPA's results-based regime, government cannot require consistency with these best management practices, although some tenure holders apply them voluntarily. In April 2016, the district manager of the Rocky Mountain District stated his expectation that forest tenure holders should consider the best management practices for ecosystem restoration when preparing replacement forest stewardship plans.

The following are some specific challenges:

- Commercial forestry focuses on the most economically viable sites and not necessarily on those that will restore well to rangelands or meet objectives for other values (e.g., species at risk, ungulate winter range). As an example, closed-forest stands with evidence of suppressed rough fescue and blue-bunch wheatgrass are more likely to restore to desired plant communities but these stands may or may not be considered economic to harvest. Also, some stands will be more likely to remain in rangeland condition while others will regenerate quickly to a dense forest of tree seedlings.
- Practice requirements in the *Forest Planning and Practices Regulation* (FPPR) were designed to meet objectives for forestry, but they may not all be appropriate or adequate to restore areas to good rangeland condition. For example, sections 35(3)(a) and (b) of the FPPR contain practice requirements that limit soil disturbance to either 5 percent or 10 percent of the net area to be reforested in a block, depending on the sensitivity of the soils. Land managers point out that 10 percent disturbance is very high for an area restored to rangelands and would prefer a much lower proportion (e.g., 1 to 2 percent).

Other measures could be applied to minimize impacts to restored rangelands. For example, land managers suggest employing local contractors with small, light machines to operate in areas identified for ecosystem restoration.

Commercial logging will likely only occur in the NDT4 when log market conditions are favorable. FLNRO has implemented policy to encourage companies to operate in NDT4 blocks.



**Figure 6.** Site disturbance from summer logging. Best management practices for grassland (open range) and open forest blocks include harvesting on frozen ground or snowpack. (Photo: East Kootenay Wildlife Association)

## Effectiveness of Actions to Improve Rangeland Condition

### Previous studies of rangeland condition

Both the area and condition of rangelands contribute to forage supply and associated capacity for grazing. Numerous reports and studies on rangeland condition in the East Kootenay have been published over the past 20 years. Long-term monitoring of restored sites has shown that ecosystem restoration, on average, doubles or triples the productivity of grass and forb species in areas treated, as well as increasing plant species diversity.<sup>ix</sup>

At the same time, removal of trees to restore rangelands does not necessarily return a site to the native plant species, such as bunchgrasses, shrubs and forbs, that are important as forage for livestock and wildlife. An analysis of ER monitoring data in 2012 showed that plant community responses to restoration were quite variable, challenging a longstanding assumption that simply opening up the forest canopy would result in an eventual return to a cover of native grassland species rather than non-native or unpalatable native grasses.<sup>x</sup>

Rangeland ecosystems recover very slowly from overgrazing and other site disturbances. Research on change in rangeland condition in the East Kootenay and elsewhere has shown that recovery of plant communities takes at least 10 years and may require decades.<sup>xi</sup> For example, one long-term study of plant community composition at several exclosure sites in the East Kootenay showed a progression over the 18 years of the study, demonstrating that rangeland condition can recover to late seral stages with proper management, ongoing treatment and enough time.<sup>xii</sup>

There are two measures of rangeland quality: rangeland condition and range health.

**Rangeland condition assessments** are used to quantitatively compare existing forage vegetation with the productive potential for the site in order to monitor changes in the state of rangelands over time.

**Range health assessments** bring together qualitative information on soils, vegetation, moisture and levels of use to identify and prioritize areas that require more intensive monitoring, restoration or management.

Range program staff conduct regular range health and forage assessments to track the effect of grazing on rangeland ecosystems. They use these assessments to identify and address problems in rangeland management. In future years, these data will also be useful to monitor how rangeland ecosystems are changing over time.

### **Board assessment of rangeland condition**

In 2015, the Board undertook an assessment of rangeland condition at benchmark sites established by the Forest Service in the late 1990s.<sup>7</sup> The purpose of the Board's re-assessment was to obtain a snapshot of the current condition of rangelands in the Rocky Mountain Trench compared to 20 years ago when collaborative rangeland management began.

All of the sites re-assessed in 2015 are in the Southern Trench, an area that has experienced some of the greatest impacts from grazing and recreational use. These sites were chosen in consultation with Board, range branch and local resource district staff to represent areas considered vulnerable to disturbance by grazing ungulates, forest ingrowth and encroachment, timber harvest, road-building, recreation activities or other potential disturbance. The assessment methods and results are described in Appendix A.

The results of the Board assessment showed that the condition of 76 percent of the sites inventoried were unchanged or improved from the original assessment 20 years ago. Seventy-two percent of sites were inventoried as being in good to excellent condition in 2015 compared to 60 percent 20 years ago. The number of sites in good condition increased from 11 to 14. Three sites improved from good to excellent condition, but another three sites declined from excellent to good condition due to patches of weeds, areas of heavy grazing or forest ingrowth (Table 1).

The number of sites in Fair condition decreased from 10 to 4, with 3 sites improving from fair to good or excellent condition and 3 sites declining from fair to poor condition. Of the three sites that changed from fair to poor condition, two had extensive site disturbance due to off-road recreational activity and the other had high weed cover and was heavily damaged by elk (Table 1).

As shown in the table of results in Appendix A, the sites assessed by the Board were subject to a variety of treatments over the 20 years preceding 2015 (no treatment; various types of ecosystem restoration treatment; reductions or adjustments to allocations for cattle grazing; or a combination of ecosystem restoration treatment and reduced cattle grazing). In addition, numbers of elk were reduced over the wider area, although the effects of this action would not be specific to individual pastures. Due to the variability of treatments in the sites, the Board was unable to comment on the effect of treatment on rangeland condition.

---

<sup>7</sup> Benchmark sites provide a baseline reference against which future conditions can be assessed.

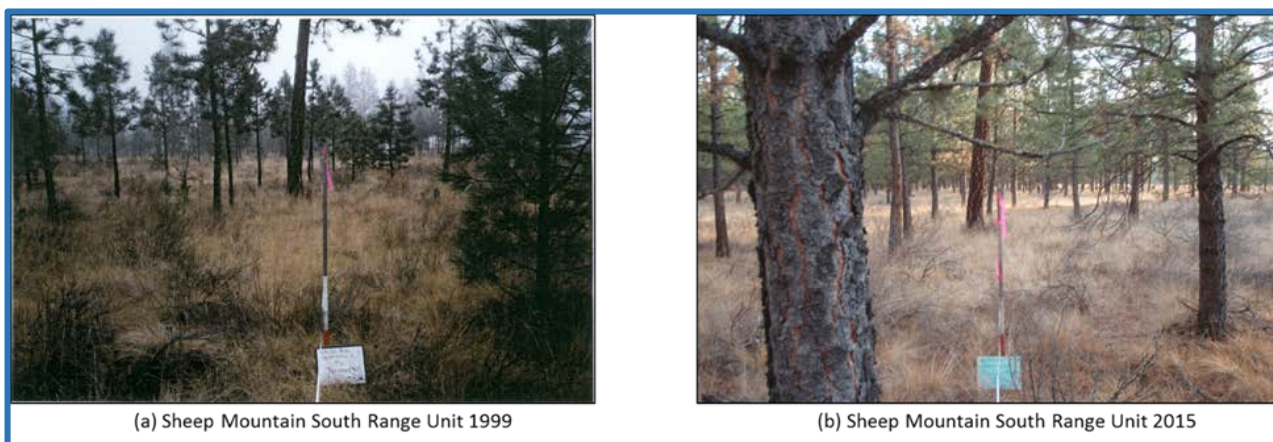


**Table 1. Reasons for Decline in Rangeland Condition at Benchmark Sites**

Change in Condition (baseline to 2015)	Reasons for Reported Decline in Rangeland Condition
Excellent to Good	<ul style="list-style-type: none"> <li>• Patches of weeds</li> <li>• Moderate to heavily grazed patches with little litter (e.g., close to water)</li> <li>• Forest ingrowth</li> </ul>
Fair to Poor	<ul style="list-style-type: none"> <li>• Significant site disturbance from off-road vehicle use</li> <li>• High weed cover</li> <li>• Heavy grazing by wild ungulates</li> </ul>

This is a cautiously positive result, in that three-quarters of sites are unchanged or have improved over the past 20 years and a greater number of sites are in good to excellent condition than previously. However, ongoing monitoring of rangeland condition is needed to track the effectiveness of management actions and inform continuous improvement.

Figures 7 to 9 are examples comparing the baseline survey year and 2015 at three sites. The dryness of the 2015 summer is evident in these photos.



**Figures 7(a) and (b).** Study site in Sheep Mountain South Range Unit in 1999 and 2015. The pasture was rated as Healthy and in Excellent condition in 2015.



**Figures 8 (a) and (b).** Study site in Grasmere Range Unit in 1997 and 2015. The pasture was rated as being in Good condition in both inventories. It was noted as Healthy with Problems in 2015 with vehicle tracks and some degraded areas in the middle. Some ingrowth of trees is visible.



**Figures 9 (a) and (b).** Study site in Newgate Range Unit in 1999 and 2015. The pasture has declined since baseline, with more patches of bare ground, high cover of invasive plants and heavy grazing by wild ungulates. This pasture was rated as Unhealthy in 2015.

## Threats to Rangeland Condition

There are a number of threats to rangeland ecosystems that have the potential to offset gains achieved through actions to restore rangelands and reduce grazing pressure. Local land managers are concerned that these threats could significantly degrade rangeland condition unless further management actions are taken.

Rangelands are particularly vulnerable to site disturbance and spread of invasive plants as caused by a variety of activities, including disturbance from forestry activities, inappropriate off-road recreational use, poor range practices, and localized over-grazing by wild ungulates and livestock. In addition, rangelands face an uncertain future under climate change.

### Control of invasive plants

The rapid spread of invasive plants is the new form of encroachment on rangeland ecosystems, reducing the quantity and quality of available forage. Land managers have observed large increases in infestations in the last three to five years and some feel the situation is out of control. This has both environmental and economic impacts, as ecosystems are altered and grazing potential is diminished. Ranchers have publicly expressed frustration that they are being penalized with loss of AUMs due to invasive species spread by other land users. Once-productive wintering ranges for wild ungulates have been heavily impacted.

The management of invasive species is a complex challenge. The sources of invasive plants are numerous and diverse. They include transportation (e.g., highways, railway lines, off-road recreational vehicle use), utility lines (e.g., pipeline and transmission line rights of way), and land-based activities that disturb the soil and move equipment or materials from site to site. Control measures need to be coordinated across activities and organizations, since actions to remove one source of infestation will not be successful if other sources are not managed at the same time. The East Kootenay Invasive Species Council<sup>8</sup> is an example of a delivery model that brings multiple parties together to work toward solutions.

<sup>8</sup> The East Kootenay Invasive Species Council (formerly the East Kootenay Invasive Plant Council) was formed in 2007, with representation from provincial and local governments, non-governmental organizations and the private sector, to coordinate the management of invasive species on public and private lands under a single-agency delivery model.

The Council staff expressed concern that some industries are not fulfilling their responsibilities to manage invasive plants under the *Weed Control Act*. The Council formed an Industry Engagement Committee in 2015 to identify industrial activities that may contribute to the spread of invasive plants and work with land managers to promote control measures and compliance with legislation. The Council has also made recommendations to forest tenure holders to strengthen results and strategies in their next round of forest stewardship plans based on best management practices for ecosystem restoration.

Controlling invasive species requires multiple strategies, including inventory, treatment, education and outreach. Several interviewees identified a lack of resources as the biggest impediment to addressing the spread of invasive plants in the East Kootenay, in particular for inventory and treatment. A three-year Invasive Species Plant Pilot Project in the East Kootenay (2005 – 2008) demonstrated the benefits of a multi-year program with secure funding for strategic planning and program implementation.<sup>xiii</sup>



**Figure 10.** Yellow hawkweed throughout a grazing enclosure at Skookumchuck. Non-native hawkweeds have become rampant in the East Kootenay in recent years.

### **Off-road recreational use**

East Kootenay rangelands are a playground for large numbers of recreationists, many from outside of the region. Gentle terrain and a lack of fencing in the East Kootenay means that off-road vehicles are not restricted to bladed roads or pre-established trails. While many off-road vehicle enthusiasts use the backcountry responsibly, it only takes a small number of vehicles off-trail to cause lasting soil damage and spread invasive plants. Rangeland soils disturbed by vehicles and camping can take decades to recover, causing economic impacts to other range users.

With over 100 000 visitors a year to the Kooconusa area alone<sup>xiv</sup> it is a challenge to monitor and enforce off-road recreation. One problem is the common perception that all public lands are open to recreational use. A situational analysis of the Kooconusa area in 2014<sup>xv</sup> recommended the development of a recreation management framework that designates some areas in which off-road recreation is prohibited and others where recreation is permitted and infrastructure is provided to minimize site disturbance, such as hard-surface roads and trails and areas for dispersed camping.

Designations that are clearly defined and broadly publicized would concentrate recreational use into areas that are less likely to cause negative impacts to other rangeland values.

The Board has previously reported the challenges of enforcing recreation activities on public lands.<sup>xvi</sup> Enforcements of damaging recreation use are possible under the *Off-Road Vehicle Act* and sections 46 (1)1.1 of the *Forest and Range Practices Act* (FRPA), however, it can be difficult to enforce violations because of difficulties with apprehending and prosecuting the individuals responsible, particularly in an area as large, accessible, and heavily used as the East Kootenay. Enforcement is easier within designated areas that are clearly off-limits to certain activities.



Figure 11. Information sign to deter damaging off-road motorized vehicle use north of the Dorr Road recreation site on Kootenay Lake.

## Site-level range practices

Cattle grazing is a significant use on the landscape and effective management of rangelands is important to long-term health and productivity of forage supply. Poor range practices can offset efforts to improve rangelands through reduced AUMs. Past Board reports have identified significant impacts to the Crown range resource throughout the province, mainly as a result of season-long grazing and poor distribution of livestock.<sup>xvii</sup>

Range practices that promote grassland health and prevent over-grazing will help to promote resiliency and reduce loss of productive rangelands to invasive plants.<sup>xviii</sup> The range branch recommends four principles for sustainable range management.<sup>xix</sup>

1. **Distribute livestock use uniformly over the range** to prevent overgrazing of areas of primary range (e.g., near water sources or shaded areas).
2. **Graze to the right level of use.**

3. **Apply enough rest during the growing season** by leaving pastures free from grazing for periods of time. Rest-rotations vary depending on the type of range.
4. **Graze at the right time and for the right duration.** As an example, spring turn-out should not occur until grasses are “range ready.”

Local ranchers are exploring innovative ways to manage their livestock, such as a grazing cooperative with a hired range rider.

Range use plans and range stewardship plans must specify measures to manage invasive plants that might result from range practices. The Board has previously recommended training to enable range tenure holders to more effectively identify and manage invasive plants.<sup>xx</sup>

### **Management of grazing by elk**

Grazing by wild ungulates continues to be heavy in some locations, despite elk populations being significantly reduced. Since it is not possible to control the timing and location of wildlife grazing, land managers are considering other measures such as:

- restoring and managing areas of low elevation rangeland specifically for grazing by elk within critical winter ranges; and
- ecosystem restoration activities at mid-elevations in the NDT3 (through logging and prescribed burns) to create migration corridors to encourage “homesteader” elk to resume migration to higher elevations in the spring and summer and relieve grazing pressure on lower elevation rangelands.

### **Climate change effects**

Plant communities in rangelands are likely to respond to climate change in various ways, depending on their growing site and individual physiologies and innate resilience to changing temperatures and levels of precipitation.<sup>xxi</sup> Ecosystems are predicted to change in composition as some species shift in their range, new species are introduced, and plant communities adapt to altered seasonal patterns of pollination and reproduction. The impacts of these changes on forage supply are not yet known. Managing pro-actively to promote healthy rangelands now will promote adaptation to climate change and the ability of plant communities to withstand undesirable climate-related agents such as high severity fire, insects and disease, and invasive plants.

## **Conclusion**

---

The management of rangelands in the East Kootenay represents 20 years of collaborative effort and is a model of multi-party management of a shared resource. Government responded to a 2008 Board recommendation to address over-grazing with several actions to reduce forage use, maintain and restore rangelands, and increase cooperation among agencies. While our analyses indicate improvements in the area and condition of rangelands, which should contribute to improved grazing opportunities, there are ongoing challenges.

To date, the ER Program has been meeting its area-based targets for progress towards desired future condition but restored rangelands will need to be maintained to prevent forest regrowth. Restoration

targets will likely be changing in the upcoming year and new arrangements to partner the ER Program with logging and wildfire management programs are intended to provide more cost-effective and efficient ways to maintain areas of grassland and open forest within these fire-maintained ecosystems. This new arrangement will help to support the local forest industry while promoting rangeland restoration.

Forestry practices can have a significant influence on the condition of rangeland areas restored by logging. The Board encourages forest tenure holders to apply locally-developed best management practices to minimize impacts to areas restored to grassland and open forest.

Rangeland condition at the sites assessed appears to be generally stable or improving, although heavy grazing by elk and poor management of cattle continue to reduce the quality of rangelands in some areas. Key threats to rangeland condition in 2016 are the spread of invasive plants and damage caused by off-road recreation. Government staff are aware of these issues and are taking steps to address them. The East Kootenay Invasive Species Council is working to control invasive plants, in collaboration with the various stakeholders with an interest in range resources. Off-road recreation is an ongoing challenge that will require collaboration across agencies and sectors. Efforts to maintain healthy rangelands will help to promote the ability of grassland and open forest ecosystems to adapt to, or withstand, climate change effects.

Overall, land managers in the East Kootenay are aware of the key issues and are actively taking steps to address them. As the manager of Crown resources in the public interest, the BC Government is demonstrating leadership in its management of East Kootenay rangelands and has an important ongoing role to set direction, encourage best practices, support monitoring, and enforce its regulatory regime to sustain the diversity of grassland and open forest values into the future.

# Appendix A: 2015 Rangeland Condition Assessment – Summary of Methods and Results

---

## Methods

In 2015, the Board engaged a consulting range agrologist from the East Kootenay to conduct rangeland condition and health assessments. The agrologist selected 25 benchmark sites in 11 range units within Rocky Mountain Natural Resource District for re-location and re-sampling to assess rangeland condition and health (Figure 12).

All of these sites had baseline data collected between 1997 and 2001. The benchmark sites were originally established in the areas within each study pasture with the most successional advanced grassland plant communities. A subset of these sites was selected for reassessment in 2015 in areas considered vulnerable to disturbance by grazing ungulates, forest ingrowth and encroachment, timber harvest, road-building, recreation activities or other potential disturbance. The sites had received a variety of treatments (no treatment; ecosystem restoration; reduced grazing; both restoration and reduced grazing) and efforts were not made to stratify the sites by treatment. Site selection took place in consultation with Board, range branch and local resource district staff.

The agrologist re-sampled the benchmark sites using an intensive survey method for rangeland condition. In order for data comparison to be meaningful, sampling procedures were identical to those used for the baseline assessments (1997 – 2001) when 5 permanent 60-metre transects were established at each site.

The plant communities along each transect were recorded and evaluated using a methodology described by Daubenmire in 1959.<sup>xxii</sup> Three levels of cover were recorded in each plot: plant species cover and frequency; tree and shrub cover; and substrate components.

Percent cover for each species was determined by averaging the cover estimates over all plots at each location and percent frequency was calculated using the following formula:

$$\text{Frequency} = \frac{\text{Number of plots with species A} \times 100}{\text{Total number of plots sampled}}$$

Plant community composition between dates was compared using Spearman's Rank Correlation procedure.<sup>xxiii</sup> For plant communities that were not similar between years, changes in plant and soil substrate cover between the baseline year and 2015 were determined using paired t-tests.

Each plant community’s response to grazing disturbance was assessed using the rangeland condition model developed by Dyksterhuis,<sup>xxiv 9</sup> in consideration of patterns of temperature and growing season precipitation between sampling periods.

Each benchmark sampling location has permanent photopoints that provide a visual record of changes at the site.

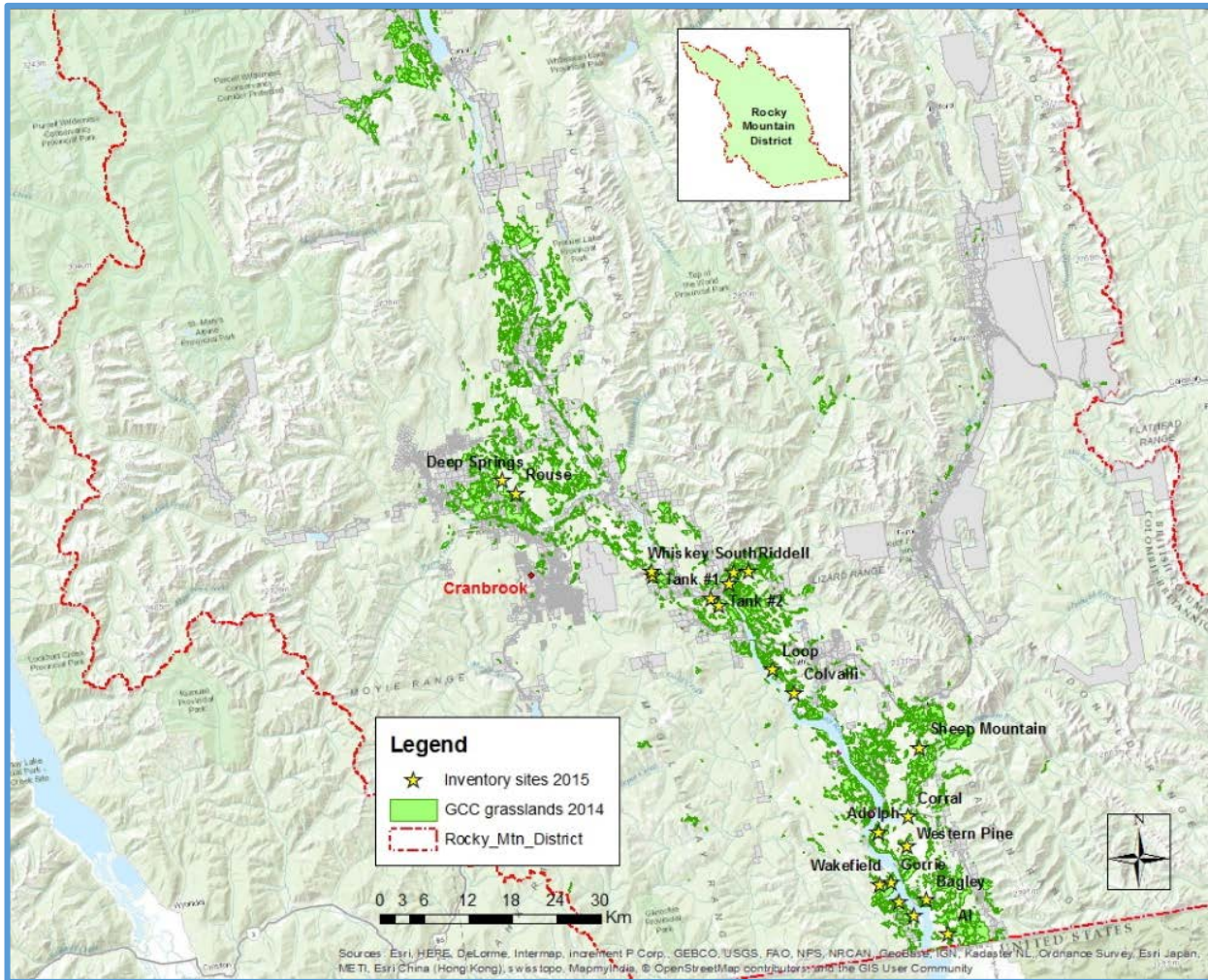


Figure 12. Grassland benchmark study sites.

<sup>9</sup> The Dyksterhuis method rates grassland condition according to the percentage of increasers, decreaseers and invaders in each plant community.<sup>xxiv</sup> *Decreasers* are late seral grasses and forbs that are very palatable as forage. As a result, these species get eaten first and become less dominant in plant communities with increased grazing intensity. *Increasers* are early seral grasses and forbs that are generally unpalatable as forage, so tend to become more dominant as decreaseers decline or even disappear from plant communities. *Invaders* are introduced or weedy species that appear once heavy grazing has weakened the existing native plant community. In general, the higher the percentage of decreaseers in the plant communities, the better the condition rating (rating categories: excellent, good, fair poor).



## Range Health Assessments

The agrologist conducted range health assessments at each site to supplement the information collected from the intensive survey. Range health assessments followed the methodology developed by the Government of Alberta (Figure 13).<sup>xv</sup> The scores for each of five indicators on the range assessment form are added to create a final percentage that classifies the rangeland as unhealthy, healthy with problems, or healthy.

Grassland Range Health Assessment - Score Sheet							
Site _____		Observer _____		Date _____			
LSD _____	Quarter _____	Section _____	Township _____	Range _____	Meridian _____	Photo # _____	
GPS Coord (NAD 83) Lat. _____		Long. _____		Estimated forage production _____		lb/ac or kg/ha	
Special Observations (climate, changes in management) _____							
<b>Scoring</b> (circle appropriate values and add their sum to the SCORE box):							
<b>1. What kind of plants are on the site? What is the plant community?</b>							
<b>Dominant species</b>							
Grasses & Grasslikes	% Cover	Forbs	% Cover	Shrubs	% Cover	Trees	% Cover
Community Type _____							
<b>Ecological Status</b> (choose 1A or 1B)				Comments		Score	
1A	Native Grassland:	24	16	8	0		
1B	Modified Grassland:	9	5	0	-		
<b>2. Are the expected plant layers present?</b>							
<b>Community Structure</b>		6	4	2	0	Comments	
						Score	
<b>3. Does the site retain moisture?</b>							
<b>Litter cover and Distribution</b>		15	8	0	-	Comments	
						Score	
<b>4. Is there accelerated soil erosion? Site Normally (circle) Stable / Unstable</b>							
<b>Site Stability</b>		Comments				Score	
4.1	Erosion:	6	4	2	0	Human caused bare soil (%) _____ Moss & lichen cover (%) _____	
4.2	Bare Soil:	3	2	1	0		
<b>5. Are noxious weeds present? (score using density distribution guide on back page)</b>							
<b>Noxious Weeds</b>		Dominant species		% Cover		Density Dist.	
5.1	Canopy Cover	3	2	1	0	Comments	
5.2	Density Distribution	3	2	1	0	Score	
<b>Grazing Intensity</b> (est. Long Term (circle)): U / U-L / L / L-M / M / M-H / H				<b>Site Score</b> (total all scores)			
<b>Trend</b> (apparent - circle): Upward / Downward / Stable / Unknown							
<b>Observed Utilization</b> _____ %		(Site Score ÷ 60 x 100) = Percent Health Rating ( _____ ÷ 60 x 100) = _____ % <b>Healthy = 75-100%; Healthy with problems = 50-74%; Unhealthy &lt; 50%</b>					

Figure 13. Rangeland health assessment score sheet (Source: Government of Alberta 2005)

## Results

The results of rangeland condition assessments are summarized in Table 2.

**Table 2.** Results of Rangeland Condition Assessments at 25 Benchmark Sites in 2015

Range Unit	Pasture ID	Years Since Baseline Inventory	Baseline Condition Class	Condition Class in 2015	Change in Rangeland Condition	Range Management by Range Unit	Ecosystem Restoration Treatment (year)*	Years Between First ER Treatment & 2015 Assessment
Colvalli	Colvalli_1	15	Fair	Fair	Stable	No changes in AUMs	No ER treatment	n/a
Cranbrook/ Ft. Steele	Cbrook_FtSteele_1	19	Fair	Poor	Declined	No changes in AUMs	No ER treatment	n/a
Cranbrook/ Ft. Steele	Cbrook_FtSteele_2	19	Fair	Poor	Declined	No changes in AUMs	No ER treatment	n/a
Grasmere	Grasmere_1	18	Good	Good	Stable	AUMs reduced in 1997 (815 to 765) Tenure not used 2012-2013	Space 1999; burn 2000; log (east) 2014	16
Grasmere	Grasmere_2	18	Good	Good	Stable	In 2003, reduced AUMs from 889 to 550	Space 1999 - 2000; burnt 2000 - 2001	14
Grasmere	Grasmere_3	18	Good	Good	Stable		Space (east) 2001; burn 2003; space (southeast) 2002; burn 2004; space (north) 2000; burn 2001, 2004	11 to 14
Grasmere	Grasmere_4	18	Good	Good	Stable	AUMs reduced in 2010 (1188 to 785). Only 50% of AUMs used in 2006 and 189 AUMs (24%) used 2011-2013	No ER treatment	n/a
Grasmere	Grasmere_5	18	Good	Good	Stable		Burn 2000; log 2014	15
Grasmere	Grasmere_6	18	Excellent	Good	Declined		No ER treatment	n/a

Range Unit	Pasture ID	Years Since Baseline Inventory	Baseline Condition Class	Condition Class in 2015	Change in Rangeland Condition	Range Management by Range Unit	Ecosystem Restoration Treatment (year)*	Years Between First ER Treatment & 2015 Assessment
Gold Creek/ Plumbob	GoldCk_Plumbob_1	18	Good	Good	Stable	AUMs reduced in 2000 from 1263 to 907. Had partial surrender prior of the tenure in 2015 and the remaining AUMs were reduced from 450 to 280.	2008 (wildfire)	7
Gold Creek/ Plumbob	GoldCk_Plumbob_2	18	Fair	Good	Improved		Burn 2005;	10
Newgate	Newgate_1	16	Fair	Fair	Stable but declining trend	AUMs were reduced early in 2016 from 966 to 600.	Space 2004; burn 2004	11
Newgate	Newgate_2	16	Fair	Excellent	Improved		No ER treatment	n/a
Pickering Hills	PickeringHills_1	18	Fair	Poor	Declined	In 2001, AUMs were reduced from 2213 to 1698. AUMs reduced again in 2008 to 1327. AUMs were increased in 2014 to 1447.	No ER treatment	n/a
Pickering Hills	PickeringHills_2	18	Fair	Fair	Stable	No changes in AUMs	No ER treatment	n/a
Powerplant	Powerplant_1	13	Good	Good	Stable	In 2009 AUMs reduced from 434 to 341. AUMs reduced again in 2013 from 341 to 221.	Burn 1998; space 2001; burn 2001	17
Powerplant	Powerplant_2	13	Good	Excellent	Improved		Burn 1998	17
Rampart/ Mayook	Rampart_Mayook_1	13	Good	Good	Stable	1058 AUMs assigned but only 886 AUMs were used in 2011 and 2012, and 868 AUMs used in 2013-2015	No ER treatment	n/a
Rampart/ Mayook	Rampart_Mayook_2	13	Fair	Fair	Stable		Log 2001; burn 2006	14
St. Mary's Prairie	StMaryPrairie_1	15	Excellent	Good	Declined	No change in AUMs, but in 2005 additional area added to tenure to spread out AUMs. Rouse Pasture added to tenure in 2013 to further spread out AUMs, resulting in a reduction over the entire area.	Space 1998 - 2002, 2010; burn 2005	17

Range Unit	Pasture ID	Years Since Baseline Inventory	Baseline Condition Class	Condition Class in 2015	Change in Rangeland Condition	Range Management by Range Unit	Ecosystem Restoration Treatment (year)*	Years Between First ER Treatment & 2015 Assessment
St. Mary's Prairie	StMaryPrairie_2	15	Excellent	Excellent	Stable	Tenure for 167 AUMs prior to surrender in 2009. Kept vacant to 2013 when the pasture combined with the tenure for Deep Springs pasture (see above).	North portion logged 2013	2
Tokay Hills	TokayHills_1	14	Excellent	Good	Declined	In 2006, AUMs reduced from 525 to 343. Tenure holder has only been using 200 AUMs since 2009.	No ER treatment	n/a
Tokay Hills	TokayHill_2	14	Good	Good	Stable		No ER treatment	n/a
Waldo	Waldo_1	16	Good	Good	Stable	Area is authorized for 1020 AUMs, but tenure holder only utilizes 750 AUMs.	Space 2001, 2004 2009; log 2010	14
Waldo	Waldo_2	16	Fair	Excellent	Improved	In 2007, AUMs reduced from 842 to 792. Tenure holder only utilized 50% of authorized AUMs (approx. 400 AUMs) until 2011. The tenure was not used between 2012 and 2015. The area will be re-tenured in 2016 for 300 AUMs.	1998; space 2008; thin 2009; Burn 2013	17

\* These dates reflect ecosystem restoration treatments since the start of the ER Program in 1997; they do not include maintenance burns from the 1970s and 1980s.

## ENDNOTES

---

- <sup>i</sup> Gayton, D. 2002. Beyond the Trench Wars: Resolving Elk-Cattle Conflicts in the Canadian Rockies. Bugle May/June 2002. Available at <http://trench-er.com/public/library/files/gayton-2002-trench-war.pdf>
- <sup>ii</sup> Pitt, M.D. 1982. East Kootenay Problem Analysis: The Interactions Among Grass, Trees, Elk and Cattle. Ministry of Forests, Research Branch, Victoria BC. Available at <http://trench-er.com/public/library/files/pitt-1982-problem-analysis.pdf>
- <sup>iii</sup> Forest Practices Board. 2008. Wildlife and Cattle Grazing in the East Kootenay. Report # FPB/IRC/144. Available at <https://www.bcfpb.ca/reports-publications/reports/wildlife-and-cattle-grazing-east-kootenay/>
- <sup>iv</sup> BC Ministry of Forests, Lands, and Natural Resource Operations. 2011. Letter in response to the Forest Practices Board's recommendation in its investigation report Wildlife and Cattle Grazing in the East Kootenay (July 2008). Dated March 17 2011. Available at <https://www.bcfpb.ca/sites/default/files/reports/IRC144-Govt-Response-to-Board.pdf>
- <sup>v</sup> Forest Practices Board. 2015. Follow-up Report on Wildlife and Cattle Grazing in the East Kootenay. Report #FPB/SR/51. Available at <https://www.bcfpb.ca/reports-publications/reports/follow-report-wildlife-and-cattle-grazing-east-kootenay/>
- <sup>vi</sup> Ross, T. and B. Wikeem. 2002. Deer, Elk and Cattle in the East Kootenay: Conflicts and Resolution. Available at [http://www.peaceforage.bc.ca/Wildlife%20Mitigation%20Info/Mitigation%20info/Ungulate%20Control/Kootneys/Kootneys\\_Deer\\_Elk\\_and\\_Cattle\\_Conflicts\\_and\\_Resolution.pdf](http://www.peaceforage.bc.ca/Wildlife%20Mitigation%20Info/Mitigation%20info/Ungulate%20Control/Kootneys/Kootneys_Deer_Elk_and_Cattle_Conflicts_and_Resolution.pdf)
- <sup>vii</sup> BC Ministry of Forests, Lands and Natural Resource Operations, Range Branch. April 2015. Landbase Analysis to Identify Fire Maintained Ecosystem Restoration Opportunity in BC: Final Report. Prepared by Forsite Consultants Ltd., Salmon Arm, BC.
- <sup>viii</sup> Rocky Mountain Trench Ecosystem Restoration Program. 2014. Ecosystem Restoration Best Management Practices for Planning, Layout, Harvesting, Silviculture and Reclamation of Open Range and Open Forest Blocks. Final – April 7<sup>th</sup> 2014. Available at [http://trench-er.com/public/library/files/SWP\\_Ecosystem\\_Restoration\\_Final.pdf](http://trench-er.com/public/library/files/SWP_Ecosystem_Restoration_Final.pdf)
- <sup>ix</sup> Berg, G.M. 2011. Vegetation change following burning and/or thinning in Rocky Mountain Forest District 2000 – 2011. Ministry of Forests, Lands and Natural Resource Operations, Range Branch, Ecosystem Restoration Section.
- <sup>x</sup> Page, H. 2014. Rocky Mountain Trench Ecosystem Restoration Monitoring Compilation. Available at [http://trench-er.com/public/library/files/Rocky\\_Mountain\\_Trench\\_ER\\_Monitoring\\_Compilation-final.pdf](http://trench-er.com/public/library/files/Rocky_Mountain_Trench_ER_Monitoring_Compilation-final.pdf)<sup>xi</sup>
- Forest Practices Board. 2007. The Effect of Range Practices on Grasslands: A test case for upper grasslands in the south central interior of British Columbia. Report # FPB/SIR/19. Available at <https://www.bcfpb.ca/reports-publications/reports/effect-range-practices-grasslands/>
- <sup>xii</sup> Wikeem, B.M., T.J. Ross, and R.F. Newman. 2012. Long-term Effects of Cattle and Wildlife Grazing on Grassland Plant Community Recovery in the East Kootenay Region of British Columbia. BC Government Technical Report 072. Available at <https://www.for.gov.bc.ca/hfd/pubs/docs/Tr/Tr072.htm>
- <sup>xiii</sup> Wikeem, B. 2007. East Kootenay Invasive Plant Pilot Project Review. Prepared for the Inter-Ministry Invasive Plant Working Group, Victoria, BC and the East Kootenay Invasive Plant Pilot Project, Cranbrook, BC.
- <sup>xiv</sup> Zumundo Community and Environmental Planning. 2015. Kooconusa Area Situational Analysis and Recommendations for Crown Land Recreation. Prepared for the Kooconusa Recreation Steering Committee. Available <http://kooconusarecreation.ca/images/documents/Kooconusa-Area-Situational-Analysis-and-Recommendations-for-Crown-Land-Recreation-full-report.pdf> [accessed October 7 2015].
- <sup>xv</sup> Zumundo Community and Environmental Planning. 2015. Kooconusa Area Situational Analysis and Recommendations for Crown Land Recreation. Prepared for the Kooconusa Recreation Steering Committee. Available <http://kooconusarecreation.ca/images/documents/Kooconusa-Area-Situational-Analysis-and-Recommendations-for-Crown-Land-Recreation-full-report.pdf> [accessed October 7 2015].
- <sup>xvi</sup> Forest Practices Board. 2010. Off-road Vehicle Management in the Kamloops Forest District. Report #FPB/IRC/165. Available at <https://www.bcfpb.ca/sites/default/files/reports/IRC165%20-%20Sonora.pdf>
- <sup>xvii</sup> Forest Practices Board. 2009. Range Planning under the Forest and Range Practices Act. Report #FPB/SIR/26. Available at <https://www.bcfpb.ca/sites/default/files/reports/SIR26-Range-Planning-under-FRPA.pdf>
- <sup>xviii</sup> Forest Practices Board. 2010. Follow-up Report: Update on Control of Invasive Plants. Report #FPB/SR/38. Available at <https://www.bcfpb.ca/sites/default/files/reports/SR38%20-%20Follow%20Up%20Report%20-%20Update%20on%20Control%20of%20Invasive%20Plants%20-%20WEB.pdf>

- 
- <sup>xix</sup> Fraser, D. 2013. The Four Principles of Range Management. Rangeland Health Brochure 13. Range Branch, Ministry of Forests, Lands and Natural Resource operations.
- <sup>xx</sup> Forest Practices Board. 2010. Follow-up Report: Update on Control of Invasive Plants. Report #FPB/SR/38. Available at <https://www.bcfpb.ca/sites/default/files/reports/SR38%20-%20Follow%20Up%20Report%20-%20Update%20on%20Control%20of%20Invasive%20Plants%20-%20WEB.pdf>
- <sup>xxi</sup> Gayton, D. 2013. British Columbia's grassland resources and climate change. *Journal of Ecosystems and Management* 14(2): 1 – 16. Available at <http://jem.forrex.org/index.php/jem/article/viewFile/135/495>
- <sup>xxii</sup> Daubenmire, R. 1959. Canopy coverage method of vegetation analysis. *Northwest Science* 33: 43 – 64.
- <sup>xxiii</sup> Zar, J.H. 1996. *Biostatistical analysis*. 3rd. ed. Prentice Hall, New Jersey
- <sup>xxiv</sup> Dyksterhuis, E.J. 1949. Condition and management of rangeland based on quantitative ecology. *Journal of Range Management* 2:104 – 115.
- <sup>xxv</sup> Adams, B.W., G. Ehlert, C. Stone, D. Lawrence, M. Alexander, M. Willoughby, C. Hincz, D. Moisey, A. Burkinshaw, J. Carlson, and K. France. 2009. *Rangeland Health Assessment for Grassland, Forest and Tame Pasture*. Publication number T/044. Government of Alberta.



**Forest  
Practices  
Board**

PO Box 9905 Stn Prov Govt

Victoria, BC V8X 9R1 Canada

Tel. 250.213.4700 | Fax 250.213.4725 | Toll Free 1.800.994.5899

For more information on the Board, please visit our website at: [www.bcfpb.ca](http://www.bcfpb.ca)