An assessment of the current RUP for 8 pastures in the Lac du Bois Grasslands

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Abstract

The Lac du Bois grasslands are complex ecosystems that provide critical habitat to a wide array of species, various recreational opportunities and economic benefits through their rotational grazing abilities. This paper aimed to address the effectiveness of current range management plans (Ministry of Forests, 2021) for 8 pastures within Lac du Bois. This was accomplished through field assessments on 3 different pastures in the lower, middle and upper portions of Lac du Bois. The Grasslands Monitoring Manual for BC was used to conduct a health assessment and determine plant community composition. Using the current Range Use Plans for each pasture provided by the Ministry of Forests, supply and demand was calculated to determine utilization levels. Using current plant community data from the Ministry of Forests for the 5 pastures not measured, seral stages were determined and compared to the desired plant community for all 8 pastures. The current range health of the lower, middle and upper grasslands were analyzed by calculating their average health scores of various categories. The results showed varied success in current management plans, with only 3 pastures having current plant communities matching desired plant communities, indicating inconsistencies in management. While the rotational grazing system attempts to provide sufficient rest periods, discrepancies suggested some adjustments to be made to improve long-term health of the grasslands. The grassland health scores showed grazing pressure not to be excessively high, and that other stressors may lead to a hindered recovery. Continued adjustments to the Range Use Plan are important to improve or maintain the healthy and functioning of these critical ecosystems.

Table of Contents

Tables of Figures and Tables

Introduction

The Lac du Bois grasslands are located northwest of Kamloops, within the Bunchgrass biogeoclimatic zone, and contain the upper, middle, and lower grassland communities. The Lac du Bois grasslands was established as a protected area in 1996 under the *Environment and Land Use Act* that is within the asserted territory of many First Nations but Tk'emlups te Secwepemc is the closest to the protected area and considered a partner in collaborative management of the protected area by BC Parks (Lac du Bois Grasslands Protected Area Management Plant 2023). First Nations used the grasslands and forests for hunting and gathering of natural materials for food, clothing, medicine and tools long before the arrival of fur traders in the 1800's; traditional First Nation uses of the protected area is still ongoing (Lac du Bois Grasslands Protected Area Management Plant 2023). Lac du Bois Grasslands is also a popular area for hiking, mountain biking, horseback riding and ski touring, orienteering, wildlife viewing, photography and motorized recreation on specified open roads (Lac du Bois Grasslands Protected Area Management Plant 2023). The Lac du Bois area has a long history of use for livestock grazing, the lands surrounding the protected area are managed for a variety of uses including range use, wildlife management, interpretive forest, research, all-terrain-vehicle (ATV) use, community watershed, timber production, and community and residential use (Lac du Bois Grasslands Protected Area Management Plant 2023). Lac du Bois Grasslands Protected Area also plays an important role for research, education and interpretation on grassland ecosystems, historic use of grasslands and grassland stewardship, and provides a major connection to nature for residents and visitors to Kamloops (Lac du Bois Grasslands Protected Area Management Plant 2023).

The Lac du Bois and Watching Creek Range Use Plan (Ministry of Forests, 2021) outlines the grazing schedule to achieve desired plant communities based on the current plant community (CPC) and desired plant community (DPC), which pertain to the objectives for this range unit. Table 1 shows the grazing rotation for the Lac du Bois and Watching Creek range from the Ministry of Forests. Understanding the range use plan will determine if the current management plan is effective in maintaining the health of the plant communities in Lac du Bois. The Range Use Plan (Ministry of Forests,

2021) is used to identify if the CPC of the site matches DPC. To assess the effectiveness of the range management in Lac du Bois grasslands, we have used collected and historical data to calculate forage demand/supply, determine seral stages and range health.

Table 1. Grazing rotation for the years 2022-2025, with corresponding Animal Unit Months (shown in brackets), for the eight pastures present within the Lac du Bois and Watching Creek Range between 2021-2025. (Ministry of Forests 2021).

<table>
<tr><th>Year</th><th>April</th><th colspan="4">May</th><th colspan="3">June</th><th>July</th><th>Aug</th><th colspan="2">Sept</th><th colspan="2">Oct</th><th>Nov</th></tr>
<tr><th>Days</th><th>15-30</th><th>1-6</th><th>7-10</th><th>11-17</th><th>18-31</th><th>1</th><th>2-11</th><th>12-30</th><th colspan="2">All</th><th>1-15</th><th>16-30</th><th>1-28</th><th>29-30</th><th>1-30</th></tr>
<tr><td rowspan="2">2022</td><td colspan="4">Halston (745)</td><td colspan="2">Deep Lake (605)</td><td>Dairy (275)</td><td colspan="5" rowspan="6">In forested pastures</td><td colspan="2">Lac du Bois (1532)</td><td colspan="2">Long Lake (515)</td></tr>
<tr><td colspan="7">Yearlings will stay from sept 1-Nov30</td><td colspan="2">AG Canada (499)</td></tr>
<tr><td rowspan="2">2023 and 2025</td><td colspan="3">Bachelor (485)</td><td rowspan="2">Deep lake (213)</td><td colspan="3" rowspan="2">Dairy (686)</td><td colspan="2">Lac du Bois (1534)</td><td colspan="2">Long Lake (515)</td></tr>
<tr><td colspan="3">Westsyde (252)</td><td colspan="2">Yearlings will stay from sept 1-Nov30</td><td colspan="2">AG Canada (499)</td></tr>
<tr><td rowspan="2">2024</td><td colspan="4">Halston (751)</td><td colspan="2">Deep Lake (605)</td><td>Dairy (275)</td><td colspan="2">Lac du Bois (1532)</td><td colspan="2">Long Lake (515)</td></tr>
<tr><td colspan="7">Yearlings will stay from sept 1-Nov30</td><td colspan="2">AG Canada (499)</td></tr>
</table>

The grazing rotation schedule for each of the pastures in the range unit for 2022-2025 is shown in Table 1. This grazing system facilitates the movement of livestock from one pasture to another on a scheduled basis and incorporates a rest period in each pasture every season. This is done to regulate timing, duration, and intensity. The Lac du Bois

has a specialized grazing system on a rest rotation for the Halston, Deep Lake, Dairy, Batchelor and Westsyde pastures, each pasture receives a year of non-use, while other pastures are being used in the late spring to early summer. In Table 1, the Halston pasture gets rotated out with the Batchelor and Westsyde pasture every year during the same grazing period from April 15th to May 11th. The Deep Lake and Dairy pastures switch grazing periods every year. In 2022 and 2024 Deep Lake will have a longer grazing period from May 12th to May 31st and the Dairy pasture will have a shorter grazing period from June 1st to June 11th. In 2023 and 2025, Deep Lake will still be the first pasture to be grazed but the grazing period is shorter, starting from May 12th to the 17th and Dairy pasture will have a grazing period from May18th to June 11th. All eight pastures have a rest period starting from June 12th to September 15th every year. During the fall seasons, a deferred grazing rotation is used, meaning each pasture will periodically not be grazed until after seed set**.** This system is used on the Lac du Bois, Long Lake and AG Canada pastures every year to enhance recovery of disturbed areas.

Objectives

The primary objective of this report is to indicate whether the current range management system is effective for plant community management in the Lac du Bois grasslands and whether it represents the desired plant communities through an assessment of the range use plan (Ministry of Forests 2021). Field data collected at Halston (lower grasslands), Long Lake (middle grasslands) and Lac du Bois (upper grasslands) pastures will be compared with previously collected data from 8 pastures in the Lac du Bois grasslands.

This will be accomplished by:

- Calculating supply and demand to determine utilization using the data provided by the Ministry of Forests (MoF) for each pasture.
- Comparing the current plant community (CPC) from field data collected at the Halston (lower grasslands), Long Lake (middle grasslands), and Lac du Bois (upper grasslands) pastures to the desired plant community (DPC) as defined by

the MoF and determining the seral stages of each grassland (Ministry of Forests, 2021).

- Using data from the current Range Use Plan (Ministry of Forests, 2021), the 5 other pastures (AG Canada, Dairy, Deep Lake, Bachelor and Westsyde) will be assessed to determine if their CPC matches DPC.
- Lastly, the current range health of the grasslands will be analyzed by calculating the average health scores from the lower, middle, and upper grasslands.

Methods

Site Description

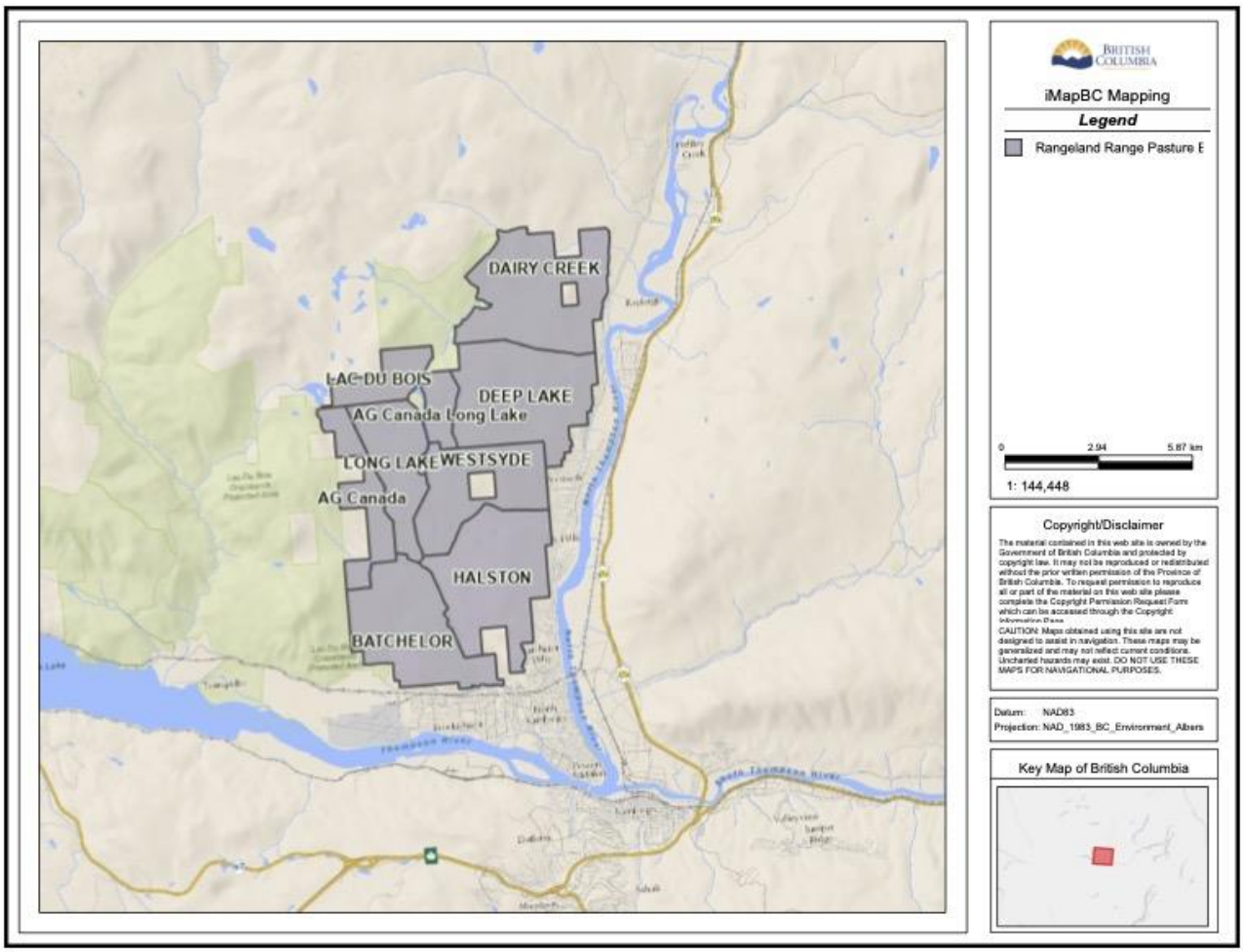

Figure 1. Map of Lac Du Bois Study Area

The study area is situated in Kamloops, BC, within the Lac du Bois grasslands, which encompass three distinct grassland communities: lower, middle, and upper. The lower grassland, found in the valley bottoms and along gentle slopes, features sparse plant cover and is primarily dominated by bluebunch wheatgrass, Sandberg's bluegrass, and big sagebrush, with forbs present but not dominant (Ministry of Forests, 2024). Transitioning to the middle grassland, located between 600 and 900 meters, the community is characterized by bluebunch wheatgrass and rough fescue, with limited shrub and low sagebrush cover (Ministry of Forests, 2024). Finally, the upper grassland, ranging from 900 to 1200 meters, is predominantly composed of rough fescue, accompanied by few shrubs and forbs (Ministry of Forests, 2024). All three grassland communities face disturbances from high recreational use, impacting their ecological integrity.

The Range Use Plan includes eight pastures, but surveys were conducted in only three: the Halston pasture in the lower grassland, the Long Lake pasture in the middle grassland, and the Lac du Bois pasture in the upper grassland. Each of these pastures featured six survey sites, which were distributed amongst nine research groups. Sites one, two, and three were surveyed twice to ensure each group had data, making nine replicate sites for each grassland type.

Field Methods

Field data was collected in September 2024 across the Halston, Long Lake, and Lac du Bois pastures. Each pasture followed a standardized methodology, beginning with the completion of the Field Sampling Location Form. This form captures essential site details, including pasture name, grassland type, group members, plot coordinates, plot direction, field notes, and a map for site access. Once the form is filled out, researchers complete the Grassland Photo-Point Monitoring Sheet, which uses photographs to track the health of the pasture over time (Grassland Conservation Council of British Columbia, 2019). A 50-meter transect line is established with three points: one at 0 meters where a stadia rod is placed, another at 2 meters, and the last at 10 meters. Three photos are taken with a consistent zoom. The zoom is set by the bottom of the

camera frame being in line with the 1-meter mark in front of the photo pin, and the top of the camera frame being in line with the 0.3-meter mark about the photo pin, which is marked with flagging for visibility. The first photograph is taken at eye level, angled downward toward the photo pin. The second photo is taken from the same location, positioning the photo pin at the bottom edge of the frame. For the final photo, the researcher stands at the 10-meter mark, centering the stadia rod in the shot (Grassland Conservation Council of British Columbia, 2019). After all photos are captured, the Photo-Point Monitoring Sheet is completed with detailed information about the site.

To assess plant community composition, The Daubenmire method was utilized, which emphasizes measuring species cover, top-down cover, and ground cover (Daubenmire, 1959). However, a few modifications were made for this study: total cover values were recorded instead of using cover classes, and quadrats were placed at 5-meter intervals rather than the standard 1-meter intervals.

To assess plant community composition, a modified version of the Daubenmire method was applied. This method emphasizes measuring species cover, top-down cover, and ground cover (Daubenmire, 1959). For this study, adjustments were made to improve efficiency: total cover values were recorded instead of using cover classes, and quadrats were spaced at 5-meter intervals along a 50-meter transect, rather than the traditional 1-meter intervals.

A 20 x 50 cm quadrant was placed in 5m intervals along a 50-meter line transect, resulting in a total of 10 plant composition samples per sampling site. To determine total cover, an estimate of the percentage of all vegetation within a frame is recorded, along with the percentage of bare ground, ensuring the two estimates sum to 100%. Ground cover was categorized into various classes, including bare mineral soil, cryptobiotic crust, litter, wood, feces, and rock, which must also equal the estimated ground cover percentage. Once total cover is established, the canopy cover by species is assessed by estimating the percent cover of each individual species within the frame; this estimate may exceed 100% if overlapping species occur. Any species that were not identified in the field were collected and taken back to Thompson Rivers University for

identification by more experienced researchers. The final step involving the frame was to categorize bare ground, crust, and litter into distinct layers. Additionally, if sagebrush was present, it's percent cover along the entire 50-meter transect is recorded. As the transect intersects each sagebrush plant, the starting and stopping lengths of each shrub are recorded (Daubenmire, 1959). These values are the summed, divided by the length of the transect line, and multiplied by 100 to get the percent cover of Big sagebrush in the area.

A Grassland Assessment Score Sheet from the Grassland Monitoring Manual for British Columbia was used to evaluate range health. A 5 by 5-meter plot was established using flags. Within the plot, key factors including bunchgrass cover, plant community structure, nutrient and hydrological cycling, site stability, and the presence and distribution of invasive species, were assessed. A specific booklet for each site was used according to site characteristics noted in Chapter 5 of the GCC Monitoring Manual. The Booklets used for each pasture were 1, 2 and 3.

Data Analysis

To determine actual level of use, forage supply and demand must be compared using a data table containing total cattle numbers in each pasture from the range use plan (Ministry of Forests, 2021). Each pasture had its forage demand converted to total forage in kilograms, then into Animal Unit Months (AUM) from 2022-2025 to show the full rotation. The AUM defined by the BC Range Act is 450 kg of forage, on dry matter basis, to sustain an average cow and its unweaned calf for a month. The Animal Unit (AU) defined by the BC Range Regulation for a cow is 1 AU (Government of British Columbia 2005), which consumes 15 kg of forage per day (450 kg divided by 30 days). A yearling is 0.7 AU, which consumes 10.5 kg of forage per day (15 kg of forage a day for a full AU multiplied by 0.7 AU equivalents), and for a bull it is 1.5 AU, which consumes 22.5 kg of forage per day (15 kg of forage a day for a full AU multiplied by 1.5 AU equivalents). To determine the forage demand, the number of a cattle type from a pasture is multiplied by the AU equivalent per day and multiplied by the number of days it is in the pasture. Total forage demand (kg) was determined by adding up the forage

demand from the respective pasture. The AUMs were then determined by dividing the total forage (kg) by 450 (Government of BC, 2004).

The MoF supplied data for the average biomass and size of each pasture to determine supply in AUMs (Ministry of Forests 2021). First the supply in total available forage (kg) (unadjusted) must be determined by multiplying the average biomass by the size of the pasture, then to get the adjusted available forage (kg), the total available forage is multiplied by 0.4, which considered the 40% of allowable use recommended by the MoF (Salm, 2016). Next, the supply in AUM is calculated by dividing the adjusted allowable use by 450 (kg). Lastly, utilization (actual level of use) is determined by dividing the forage demand by the unadjusted forage supply and multiplying by 100.

A seral stage is defined by their similarities to the Potential Natural Community (PNC) in percent ranges (Ministry of Forests, 2021). Current seral stages for the lower grasslands (Halston), middle grasslands (Long Lake) and upper grasslands (Lac du Bois) were determined by averaging the data taken from these grasslands and comparing it to the respective range type summary tables (Ministry of Forests, 2024). Using the determined seral stages of the three grasslands of Lac du Bois, tables were created to compare whether the CPC is exceeding, meeting, or below the DPC provided by the MoF (Ministry of Forests 2021). To assess the CPC for the remaining five pastures—Batchelor, Westsyde, Dairy, Deep Lake, and AG Canada—data was extracted from the existing Range Use Plan provided by the Ministry of Forests, to determine if they matched DPC.

While evaluating the range health, each key factor was assigned a value to determine whether the site has been altered and to quantify the extent of that alteration (Grassland Conservation Council of British Columbia, 2019). Using the plant community composition data, current seral stages for the Halston, Long Lake, and Lac du Bois pastures were determined. For the other pastures, seral stages were identified based on the Range Use Plan CPC and DPC provided by the Ministry of Forests. Following

the field collection the data was analyzed to draw meaningful conclusions regarding the ecological health of the studied grasslands.

Results:

Forage Supply, Forage Demand, and Actual Use

The forage supply and demand in AUMs throughout the eight pastures of the Lac du Bois grasslands is shown in Table 2. Long Lake, AG Canada and Lac du Bois pastures show a 44% actual use every year from 2022-2025 which exceeds the 40% maximum use. This means demand passes supply during those rotations. The rest of the pasture's forage demand remain relatively constant throughout the years, but the Deep Lake pasture decreases in use from 25% in 2022/2024 to 9% in the 2023/2025 rotations and the opposite can be said about the Dairy pasture, where the use is increased from 13% in the 2022/2024 rotation to 33% use in the 2023/2025 years.

Table 2. Supply and demand in AUMs and actual use in all eight pastures of the Lac du Bois grasslands from 2022 to 2025. Supply has 40% use factored in.

		2022		2023 and 2025		2024	
Pasture	**Supply (AUMs)**	**Demand (AUMs)**	**Actual Use (%)**	**Demand (AUMs)**	**Actual Use (%)**	**Demand (AUMs)**	**Actual Use (%)**
Halston	**8697**	**745**	**34**	**0**	**0**	**751**	**35**
Westsyde	**265**	**0**	**0**	**252**	**40**	**0**	**0**
Bachelor	**493**	**0**	**0**	**485**	**40**	**0**	**0**
Deep Lake	**965**	**605**	**25**	**213**	**9**	**605**	**25**
Dairy	**841**	**275**	**13**	**686**	**33**	**275**	**13**
Long Lake	**473**	**515**	**44**	**515**	**44**	**515**	**44**

AG Canada	**450**	**499**	**44**	**499**	**44**	**499**	**44**
Lac du Bois	**1394**	**1532**	**44**	**1534**	**44**	**1532**	**44**

Community Plant Composition

LOWER G:

The lower grassland community (Halston pasture) was measured to be in a late-seral condition based on most of the species falling into the late seral or PNC stage, as seen in Table 3. The dominant species, bluebunch wheatgrass, had a 16.9% cover, putting the total bunchgrass cover to 19.4% for the site. Although the other dominating species, Big sagebrush and Sandberg's bluegrass were both on the smaller side of the PNC range, the biomass exceeded the PNC amount. In addition to this, the brome was not listed (NL) in the PNC and Late Seral stage, since it was only 0.5%. Furthermore, the biological crusts, bare soil and litter cover all contributed to placing the lower grassland in the late seral stage.

Table 3. Determining seral stage condition for the lower grassland community (Halston Pasture), by comparing our data to the ecosite descriptions in the Grassland Monitoring Manual for British Columbia.

Species	PNC	Late Seral	Mid Seral	Early Seral	Our Data
Bluebunch wheatgrass	30 to 60	15 to 30	5 to 15	0 to 5	16.9
Big sagebrush	5 to 10	10 to 30	10 to 50	10 to 50	5.8
Sandberg's bluegrass	1 to 5	5 to 10	NL	NL	2.5
Pussytoes and daisies	NL	NL	0 to 20	0 to 40	4.5
Needle and thread grass	NL	5 to 10	5 to 30	0 to 40	0.5
Bromus spp.	NL	NL	5 to 10	5 to 40	2.7
Litter	5 to 30	5 to 30	5 to 30	5 to 30	31.6
Biological Crusts	10 to 30	10 to 30	5 to 10	0 to 10	19.6
Bare soil	10 to 30	10 to 30	10 to 30	10 to 30	21.4
Biomass (kg/ha)	500	400	250	150	762

MIDDLE G:

Though signs of grazing pressures are evident, the middle grasslands (Long Lake pasture) were determined to be in a late-seral stage. The dominating bluebunch wheatgrass was classified as late seral, while fescue fell just short, resulting in 17.4% of bunchgrass cover. Big sagebrush and needle-and-thread grass fall under PNC ranking, along with biomass, which exceeds the PNC average. Table 4 shows a high quantity of litter, which indicates the grazing pressure isn't too severe on the bunchgrasses. This is further supported by the low presence of big sagebrush, which would have increased opportunities to spread if the bunchgrasses were overgrazed.

Table 4. Determining seral stage condition for the middle grassland community (Long Lake Pasture), by comparing our data to the ecosite descriptions in the Grassland Monitoring Manual for British Columbia.

Species	PNC	Late Seral	Mid Seral	Early Seral	Our Data
Bluebunch wheatgrass	15 to 30	5 to 15	5 to 40	5 to 50	12.5
Fescue	15 to 30	5 to 15	1 to 5	NL	4.9
Needle grasses	NL	5 to 10	5 to 40	5 to 40	0.7
Kentucky bluegrass	NL	10 to 30	5 to 50	5 to 50	6.2
Mixed forbs	< 5	5 to 10	10 to 15	10 to 20	7.4
Big sagebrush	1	5	10	20 to 30	0.4
Litter	50 to 100	5 to 30	0 to 100	0 to 100	43.7
Biological Crusts	5 to 15	10 to 30	0 to 30	0 to 30	10.9
Biomass (kg/ha)	500	300 to 500	300	250	775

Upper Grassland

Based on the overall score, the upper grasslands (Lac Du Bois pasture) are considered to be in a mid-seral condition. A strong factor prohibiting the late-seral classification was the amount of fescue present, with bunchgrasses covering roughly 16.9% of the pasture. The large amount of biomass, mixed forbs and Kentucky bluegrass, seen in Table 5, was not enough to place the pasture in late-seral, but rather suggests that the

site has increased disturbances occurring. Additionally, the reduced litter volume also implies a degree of stressors taking place on the pasture. These factors combined aided in the decision of mid-seral for Lac Du Bois pasture.

Table 5. Determining seral stage condition for the upper grassland community (Lac Du Bois Pasture), by comparing our data to the ecosite descriptions in the Grassland Monitoring Manual for British Columbia.

Species	PNC	Late Seral	Mid Seral	Early Seral	Our Data
Bluebunch wheatgrass	1 to 5	5 to 10	5 to 40	5 to 40	5.1
Fescue	30 to 60	15 to 30	5 to 15	NL	11.8
Needle grasses	NL	5 to 10	5 to 40	5 to 40	1.1
Kentucky bluegrass	NL	10 to 30	5 to 85	NL	18.9
Mixed forbs	< 5	5 to 10	10 to 15	10 to 20	11.7
Litter	50 to 100	5 to 30	0 to 100	0 to 100	39.9
Biological Crusts	1 to 5	10 to 30	0 to 30	0 to 30	5.3
Biomass (kg/ha)	1000	800 to 1000	500 to 1500	500 to 1500	980

Current Plant Communities and Desired Plant Communities

The evaluation of the current plant communities (CPC) compared to desired plant communities (DPC) amongst 8 different pastures showed that the Long Lake, Dairy and AG Canada pastures all had CPC matching DPC. This was determined by the dominating plant species, current seral stages, and amount of litter present. The current plant communities for the Halston and Deep Lake pastures didn't quite reach the desired plant communities due to the volume of big sagebrush, preventing an increase in dominant grasses. Along with Deep Lake, the Westsyde pasture also had a high proportion of invasives and was just shy of being a late seral condition. The plant species composition for Lac Du Bois pasture lacked abundance of rough fescue and bluebunch wheatgrass, instead being dominated by Kentucky bluegrass, which could contribute to the decreased litter cover. This resulted in the CPC of Lac Du Bois pasture not matching DPC, as seen in Table 6. The furthest CPC from DPC was found at the

Batchelor pasture, where a high amount of big sagebrush and invasives put the site in an early seral condition.

Table 6. Assessment of the Current Plant Community (CPC) and Desired Plant Community (DPC) for each of the following pastures in Lac du Bois grasslands.

Pasture	Current Plant Community (CPC)	Desired Plant Community (DPC)	Comparison
Batchelor	Early seral with bluebunch wheatgrass dominating, high abundance of big sagebrush and invasives present.	Late seral with scattered bluebunch wheatgrass, some forbs and a small amount of big sagebrush.	CPC well below DPC
Halston	Late seral with bluebunch dominating and minimal big sagebrush.	Late seral with a combination of bluebunch wheatgrass, rough fescue and forbs.	CPC nearing DPC
Long Lake	Late seral, dominated by bluebunch wheatgrass, forbs and Kentucky bluegrass, minimum big sagebrush.	Late seral with a combination of bluebunch wheatgrass, rough fescue and forbs.	CPC matches DPC
Lac du Bois	Mid seral with high Kentucky bluegrass and forb cover compared to fescue and bluebunch wheatgrass.	Late seral with rough fescue as the dominant species along with forbes and bluebunch wheatgrass.	CPC is below DPC
Westsyde	Mid seral but close to late with bluebunch wheatgrass as the dominant species with forbs but invasives present.	Late seral with a combination of bluebunch wheatgrass, rough fescue and forbs.	CPC is nearly DPC
Dairy	Mid seral, rough fescue and bluebunch wheatgrass are dominant species.	The CPC is the DPC.	CPC matches DPC
Deep Lake	Mid-Late seral with scattered big sagebrush, bluebunch wheatgrass is the dominant species.	Late seral dominated by bluebunch wheatgrass and rough fescue with a combination of forbs and little big sagebrush cover.	CPC closely reaching DPC
AG	Late seral with abundant	Late seral with bluebunch	CPC

Canada	bunchgrass cover, minimum big sagebrush and invasives present.	wheatgrass dominating species with minimal big sagebrush.	matches DPC

Grassland Health Scoring

The resulting scores of key indicator assessment criteria allows grassland condition to be determined using the following scoring: reference (100-76%), slightly altered (75-51%), moderately altered (50-26%) and greatly altered (25-0%). Beginning with the key bunchgrass cover, figure 1 shows Long Lake and Lac Du Bois tied at 26.7 points, while a rather low total of 20 points was scored for the Halston pasture. Plant community structure was low across all pastures compared to the reference condition, with Long Lake (2.1) scoring the lowest. While litter weight was extremely low for Lac Du Bois (1.6), presumably from increased disturbances, Halston (5.6) and Long Lake (6.4) were also small compared to the reference (14). In Halston pasture, bare soil was very low (1), on account of high biological crust and litter cover, while the other pastures measured between 5.2-6.3. Erosion features nearly reached reference condition for Halston (6.1), Long Lake (7.3) and Lac Du Bois (7.1), as well as similarly low invasive plant assessed cover, though invasive plant distribution was slightly more in Lac Du Bois (2.6)

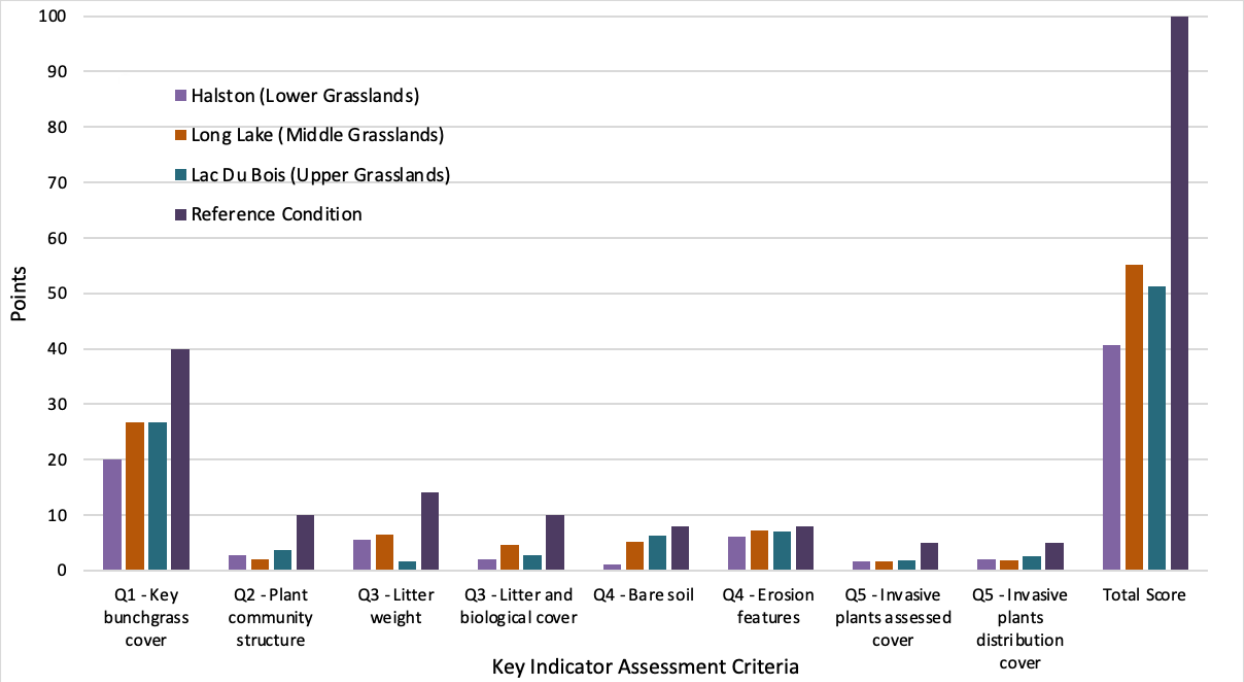

Figure 2. Comparing reference conditions to key indicator assessment scores for the Halston pasture (lower grassland), Long Lake pasture (middle grassland) and Lac du Bois pasture (upper grassland) in order to determine each pasture's status.

Using these indicators, we can see in figure 1 that none of the grassland ecosystems are very close to the reference condition, however the Long Lake pasture (middle grasslands) scored the highest overall with 55.2 points in the moderately altered state. A final count of the Lac Du Bois (upper grasslands) characteristics resulted in second place with 51.3 points. Both pastures ranked as slightly altered conditions, the upper grassland's lower score indicates more stress or disturbances occurring in the ecosystem. Finally, the Halston pasture (lower grasslands) tallied 40.6 points overall, placing it in the moderately altered condition category.

Discussion:

This study examined the effectiveness of current range use plans (RUPs) for managing the grassland communities of various pastures. Results indicate mixed success: while some pastures are well-aligned with DPC, others display deviations that raise concerns about long-term ecological health and sustainability.

Within the lower grassland pastures, the late seral plant community of the Halston pasture is dominated by bluebunch wheatgrass with minimal big sagebrush, putting it in close range of reaching DPC (Table 6). Whereas the Batchelor pasture is well below DPC due to the high abundance of big sagebrush and invasive species present, which places it in the early seral stage (Ministry of Forests, 2021). Although these rotating pastures have relatively similar usage, with the Halston pasture having 35% use in 2024 and Batchelor pasture providing 40% use in 2023 (Table 2), there is a notable difference in their plant communities. Apart from grazing, another factor that could contribute to this variation in plant communities is drought. The lower grassland communities experience long periods of extremely dry conditions, but annual recurrence of prolonged drought effects could present negative effects on the plant communities. Furthermore, increased levels of recreational activities could contribute to plant communities not reaching DPC. Batchelor is the first pasture on Lac du Bois road, therefore it provides the closest access for hiking, mountain biking and dirt biking activities which increase the level of disturbance.

For the middle grasslands, both AG Canada and Long Lake pastures had abundant bunchgrass cover with minimal big sagebrush present, allowing their CPC to reach DPC (Table 6). This is notable since both pastures have grazing usages of 44% annually (Table 2). Despite the high level of usage, both pastures are able to reach their desired plant communities, making it apparent that this amount of grazing intensity is appropriate for them at this time. Considering that Long Lake scored the highest, reflects its proximity to reference conditions. This suggests that grazing in this pasture is better aligned with the ecosystem's carrying capacity, allowing for better nutrient cycling, hydrological stability, and minimal invasive plant distribution. Additionally, the dominating bunchgrasses and litter cover indicate that overgrazing is not occurring on these pastures. As for the Westsyde pasture, despite dominating bluebunch wheatgrass on site, the presence of invasive species and mid-seral stage of the plant community prevented it from reaching DPC (Ministry of Forests, 2021). Even though Westsyde is given a year to rest between grazing periods, the 40% usage could potentially be too high for this pasture. While the rotational grazing system attempts to provide sufficient

rest periods, conflicts in forage demand versus supply indicate that stocking rates or grazing periods may require adjustment to improve long-term health of the grasslands.

In the upper grasslands, the Dairy pasture had dominating bluebunch wheatgrass and rough fescue, allowing for the mid-seral plant community to reach DPC. This suggests that the current annual alternating grazing intensities of 13% and 33% is effective for this pasture. On the other hand, the Deep Lake pasture was just short of reaching DPC with a mid-seral plant community containing scattered big sagebrush. Although this pasture is also on an alternating grazing intensity, switching between from 9% and 25% each year, the inability to reach DPC indicates that grazing pressures and additional factors could be too harsh on the pasture. Further monitoring should continue to prevent additional decline of the pasture and adjust management accordingly to allow the site more time to recover. Lastly, the Lac du Bois pasture was further below DPC, since it was dominated by Kentucky bluegrass rather than rough fescue and bluebunch wheatgrass. This transition of dominating grass species, accompanied by reduced litter cover, suggests ecosystem stress or disturbance in the Lac du Bois pasture. This could potentially be linked to the annual 44% grazing use of the pasture, which appears to be too high and consistent for the plant community to recover. The moderately altered state of Lac du Bois highlights challenges in maintaining the health of upper grasslands under current management practices, particularly given their susceptibility to invasive species and reduced bunchgrass dominance.

Based on the results of these pastures and their ability for CPC to match DPC, it is recommended that Batchelor, Halston and Westsyde remain on a rest-rotation grazing schedule to allow the plant communities time to reestablish following their use. Current conditions suggest that, although grazing pressure is not excessively high, other stressors, such as recreational use or historical overgrazing, may be affecting recovery. Therefore, a reduction of the annual percent allowed for grazing in each pasture, to reduce pressures and prevent further spread of big sagebrush and invasive species. The overutilization in certain pastures, such as Long Lake, AG Canada, and Lac du Bois, where actual use exceeded the 40% utilization threshold, further highlights inconsistencies in management and suggest a reduction in biodiversity and soil erosion.

Rest-rotation or seasonal rotation should be considered for these pastures, for the plant community to adequately recover. Underutilization shown in pastures like Dairy and Deep Lake, can suggest that growth of undesirable species might be crowding more beneficial vegetation. Methods to increase distribution and target undesirable species, such as salt and mineral licks or water alternatives, should be considered.

Several limitations may have influenced the findings. The field data was collected by inexperienced students, which could introduce errors in plant identification, cover estimation, or health assessments. For example, variability in interpreting Daubenmire frame coverage or misclassification of plant species may affect the accuracy of results. Students have busy schedules and other classes that can take precedence at times, this may have created time constraints and scheduling conflicts for some groups. The time of year was also a constraint as data collection, since September may not fully capture the seasonal dynamics of plant communities, particularly in pastures subjected to early-season grazing. Vegetative regrowth or damage may not be fully observable late in the season. Furthermore, the severe drought that occurred over the summer increased the difficulty to identify plants, due to their “crunchy” state. To address these limitations in future studies, students could conduct multiple practice sessions under the guidance of their professors to ensure they are familiar with the correct procedures. Additionally, data collection could be scheduled during the first week of classes to optimize conditions and reduce time constraints. Proper time management should also be emphasized; creating a detailed schedule or adjusting workloads could help mitigate these challenges and improve the overall quality of the data collected.

While the current RUP (Ministry of Forests 2021) has demonstrated success in certain areas, such as Long Lake and AG Canada, discrepancies in forage utilization, invasive species spread, and deviations from DPC in other pastures. This suggests the need for refinement amongst some of the pastures facing the biggest challenges/impacts, such as Halston or Lac du Bois. Objectives to align CPC with DPC were only partially met, as five out of eight pastures failed to achieve the desired conditions. This may be attributed to challenges in implementing uniform grazing strategies across diverse grassland

types, as well as inaccuracies in forage demand estimates or delays in adaptive management responses.

Conclusion:

Overall, this study of the current RUP demonstrates partial effectiveness in managing the grassland communities of Lac du Bois. While the rotational grazing system supports healthy plant communities in certain pastures, inconsistencies in forage utilization, invasive species management, and plant community structure need improvement in other pastures. Key recommendations include adjust stocking rates and grazing periods to align with forage supply, improve monitoring protocols to reduce observer bias and improve data accuracy, and incorporating more adaptive management strategies to address site-specific challenges, particularly in Batchelor and Lac du Bois pastures. Ultimately, continuously improving the RUP through regular monitoring and adaptable strategies will be essential for maintaining the ecological health of the Lac du Bois grasslands in the face of changing environmental and management challenges.

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Appendix

Table 7. Supply calculations for each pasture including average biomass (kg/ha), size of pasture (ha) and allowable use (40%) provided by the MoF (Ministry of Forests 2021).

Pasture	**Avg Biomass (kg/ha)**	**Size of Pasture (ha)**	**Total Available Forage (kg)**	**Allowable Use (%)**	**Adjusted Available Forage (kg)**	**AUMs possible (Supply)**
	Supplied from MoF Data	*Supplied from MoF*	*Avg biomass x Area*	*Using 0.4 (40% as a general estimate)*	*Total Available Forage x Allowable Use*	*Adjusted Available Forage/ 450 kg*
Halston	762	1284	978408	*0.4*	391363.2	8697.0
Westsyde	763	878	297570	*0.4*	119028	264.5
Batchelor	486	1141	554526	*0.4*	221810.4	492.9
Deep Lake	827	1313	1085851	*0.4*	434340.4	965.2
Dairy	708	1336	945888	*0.4*	378355.2	840.8
Long Lake	775	687	532425	*0.4*	212970	473.3
AG Canada	725	698	506050	*0.4*	202420	449.8
Lac du Bois	980	1600	1568000	*0.4*	627200	1393.8

Table 8. 2022-2025 rotation years for all eight pastures with the cattle number, cattle type, and dates spent in pasture to determine forage demand, total forage (kg) and AUMs.

Year	Field	Cattle Numbers	Type	Date	Days	Forage Demand	Total Forage (kg)	AUMs
2022	Halston	848	Cows	April 15 - May 10	26	330720	335310	745
		10	Bulls	May 1 - May 4	4	900		
		20	Bulls	May 5 - May 6	2	900		
		31	Bulls	May 7 - May 10	4	2790		
2024	Halston	848	Cows	April 15 - May 10	26	330720	337785	751
		21	Bulls	May 1 - May 4	4	1890		
		31	Bulls	May 5 - May 6	2	1395		
		42	Bulls	May 7 - May 10	4	3780		
2023 and 2025	Batchelor	550	Cows	April 15 - May 10	26	214500	219765	488
		21	Bulls	May 1 - May 6	6	2835		
		27	Bulls	May 7 - May 10	4	2430		
2023, and 2025	Westsyde	298	Cows	April 15 - May 10	26	116220	118020	262
		10	Bulls	May 5 - May 6	2	450		
		15	Bulls	May 7 - May 10	4	1350		
2022 and 2024	Deep Lake	768	Cows	May 11 - Jun 01	22	253440	272250	605
		38	Bulls	May 11 - Jun 01	22	18810		
2023 and 2025	Deep Lake	848	Cows	May 11 - May 17	7	89040	95655	213
		42	Bulls	May 11 - May 17	7	6615		
2022 and 2024	Dairy	768	Cows	Jun 02 - Jun 11	10	115200	123750	275
		38	Bulls	Jun 02 - Jun 11	10	8550		
2023 and 2025	Dairy	768	Cows	May 18 - Jun 11	25	288000	308812.5	686
		37	Bulls	May 18 - Jun 11	25	20812.5		
2022 and 2024	Lac du Bois	673	Cows	Sept 16 - Sept 30	15	151425	689452.5	1532
		832	Cows	Oct 01 - Oct 05	5	62400		
		942	Cows	Oct 06 - Oct 28	23	324990		
		150	Yearlings	Sept 01 - Nov 30	91	143325		
		25	Bulls	Sept 16 - Sept 28	13	7312.5		
2023 and 2025	Lac du Bois	671	Cows	Sept 16 - Sept 28	13	130845	690382.5	1534
		731	Cows	Sept 29 - Sept 30	2	21930		
		831	Cows	Oct 01 - Oct 05	5	62325		
		941	Cows	Oct 06 - Oct 28	23	324645		
		150	Yearlings	Sept 01 - Nov 30	91	143325		
		25	Bulls	Sept 16 - Sept 28	13	7312.5		
2022 - 2025	Long Lake	468	Cows	Oct 29 - Nov 30	33	231660	231660	515
2022 - 2025	AG Canada	454	Cows	Oct 29 - Nov 30	33	224730	224730	499