BC MINISTRY OF FORESTS, OMINECA REGION

# Moose density and composition in the Robson Valley, east-central BC, Winter 2022-23


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# Abstract

We conducted a stratified random block (SRB) survey and a total count of Mount Robson Provincial Park (MRPP) to assess density and composition of moose in the Robson Valley, east-central BC. We conducted the SRB over Wildlife Management Units (WMUs) 7-1 (MRPP), 7-2, 7-3, 7-4, and 7-5, which comprise the Upper Fraser Game Management Zone (along with WMUs 7-17 and 7-18, which are flown separately as the Hart South survey area). The survey area was stratified into three strata based on moose habitat selection in early winter: an expected high moose density stratum (S1), an expected low moose density stratum (S2), and MRPP (S3). The observed bull: cow ratio was 98 ± SE 15 bulls per 100 cows, including a concentration of 250 bulls per 100 cows in MRPP. The bull ratios were well above the target 50 bulls per 100 cows for low density populations. The observed calf: cow ratio was 31 ± SE 5 calves per 100 cows. We observed 258 moose, for a sightability corrected population estimate of 1049 ± SE 135 moose or an overall density of 0.32 moose/$km^2$. Without a previous density estimate for the Robson Valley, we are not able to determine the moose population trend.

In addition to moose, we counted and classified all elk groups encountered to determine a minimum count and demographic ratios. There were 311 elk observed in 13 groups during this survey. The observed bull: cow ratio was 20 (95% CI 4-33) bulls per 100 cows. The observed calf: cow ratio was 36 (95% CI 30-41) calves per 100 cows. The number of limited entry hunt authorizations to reduce conflict with agricultural producers appears to be sustainable based on the minimum count we recorded on this survey, especially considering several herds of elk would have been missed.

Although deer abundance is not typically estimated by aerial surveys in the Omineca Region because of their low detectability, we also recorded all incidental observations of deer: 24 mule deer and 68 white-tailed deer. This is noteworthy because surveys conducted in the mid-1990s and early 2000s to identify and monitor areas for ungulate enhancement recoded a majority of mule deer. Sample sizes have been small, but the shift in relative deer abundance is also reflected in harvest data and should continue to be monitored.

## Introduction

Moose are an important species in British Columbia playing a substantive role in predator-prey systems, nutrient cycling, and forest succession (Molvar et al. 1993, McLaren and Peterson 1994). Moose populations have declined in central British Columbia by as much as 70% in the past 20 years (Kuzyk et al. 2018), but the status and trend of moose populations in the Robson Valley is unknown. Although periodic moose surveys have been completed in parts of WMUs 7-2, 7-3, 7-4, and 7-5, the objectives have been distribution, habitat selection, and relative density of ungulates and prioritization of areas for enhancement. No systematic surveys that provide reliable estimates of abundance and density of moose have been conducted in the Robson Valley/Canoe Reach area at a population level scale.

The objectives of this survey were to:

1) Provide an estimate of moose abundance and density for the Robson Valley survey area,
2) Determine estimates of key demographic parameters for moose in the survey areas (bull: cow and calf: cow ratios), and
3) Provide a total minimum count of elk and deer in the agricultural area of the Robson Valley to determine key demographic parameters and relative abundance.

## Survey Area

The Robson Valley survey area for 2023 includes Wildlife Management Units (WMUs) 7-02 to 7-05 and makes up the majority of the Upper Fraser Game Management Zone (GMZ) 7Oa. It includes the Canoe Reach of the Kinbasket Reservoir south of Valemount, north to Fraser River west of McBride (Figure 2). We excluded areas of high elevation (>1200 m ASL), lakes >100 Ha, and the municipal boundaries of Valemount and McBride from the survey area due to lack of suitable moose wintering range (Demarchi 2000). We also surveyed WMU 7-01, which is entirely composed of Mount Robson Provincial Park, with a low elevation total count.

The survey area is primarily in the Interior Cedar Hemlock (ICH) biogeoclimatic zone, with some low elevation river valleys in the Sub-Boreal Spruce (SBS) zone (Meidinger and Pojar 1991). Western redcedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) dominate the ICH. The SBS is dominated by hybrid spruce (*Picea glauca x engelmanni*) and subalpine fir (*Abies lasiocarpa*), except in early successional stands of lodgepole pine (*Pinus contorta*) and trembling aspen (*Populus tremuloides*) (Meidinger and Pojar 1991). High elevations in the subalpine are characterized by the Engelmann Spruce-Subalpine Fir (ESSF) zone, dominated by Engelmann spruce (*Picea engelmanni*) and subalpine fir. Treeless Alpine Tundra (AT) occurs above treeline.

The survey area is extensive, and overlaps the traditional territory of several First Nations, including Adams Lake Indian Band, Canim Lake Band, Ktunaxa Nation Council, Lheidli T'enneh Band, Lhtako Dene Nation, Little Shuswap Lake Band, Neskonlith Indian Band, Northern Secwepemc te Qelmucw, Shuswap Band, Simpcw First Nation, and Xat'sull First Nation.

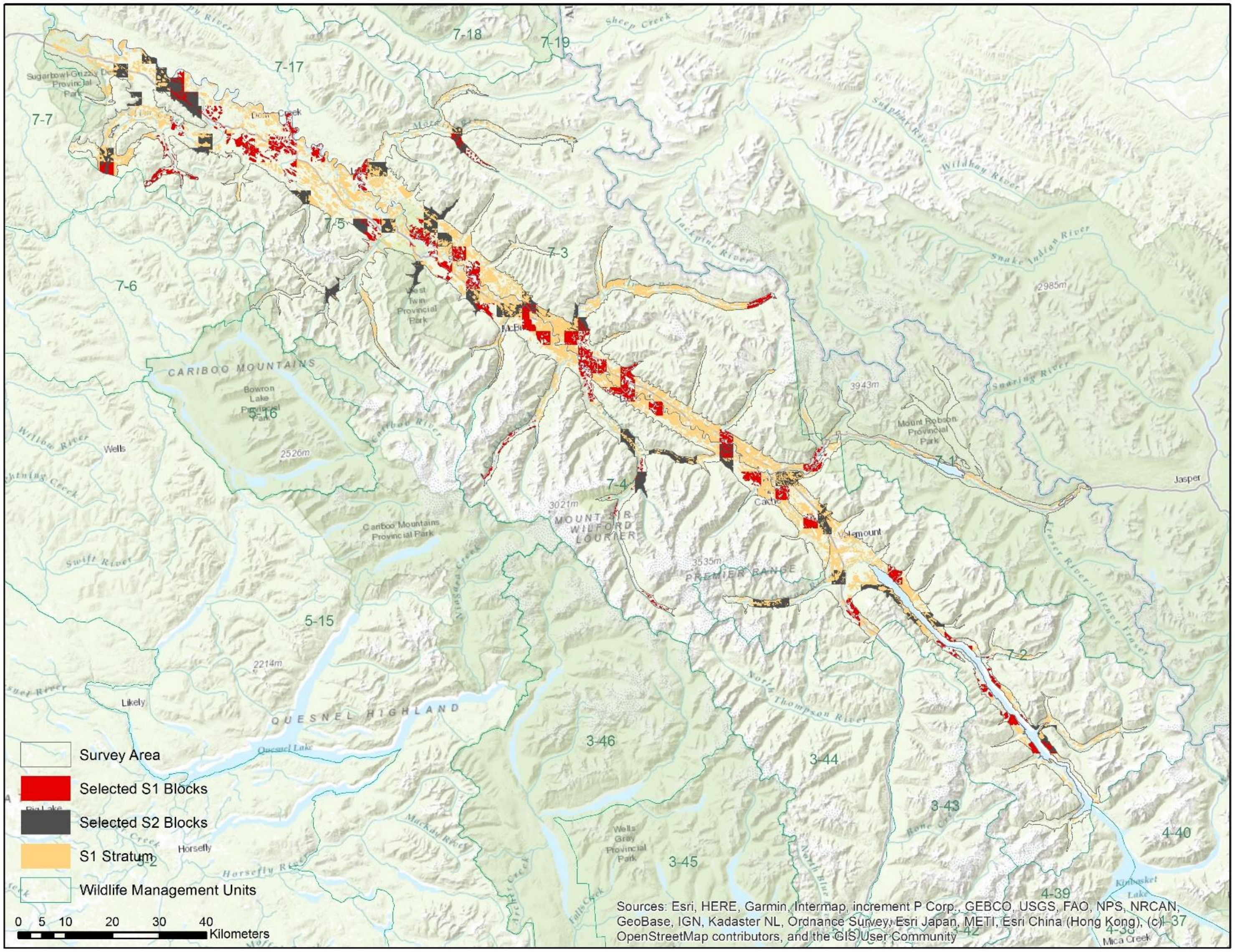


**Figure 1. Robson Valley moose survey area with high density habitat stratum (S1) highlighted in yellow (red for selected S1 blocks). Selected low density habitat (S2) is shown in grey. The Mount Robson total count block was not flown by strata.**

# Methods

We used a stratified random block (SRB) survey design to estimate population size, with the survey area stratified into expected high moose density (S1) and expected low moose density (S2) strata based on forest cover classes used by moose in early winter (Gasaway *et al.* 1986, Heard *et al.* 1999, BC RISC 2002, Heard *et al.* 2008). We used Vegetation Resource Inventory (VRI) and Reporting Silviculture Updates and Land Status Tracking System (RESULTS, updated to 2022) data from the British Columbia Land and Data Warehouse to define two domains: S1 and S2. Stratum 1 (S1, high value moose habitat) includes forests between 5 and 40 years of age, shrubby areas, and deciduous-leading stands. We classified the remaining habitat as Stratum 2 (S2, low value moose habitat), which includes primarily >40-year-old coniferous-leading stands, as well as other forest stands <5 and >40 years of age, muskeg, swamps, and non-vegetated areas (gravel bars, rock outcrops, roads). We excluded areas over 1200 m in elevation and lakes >100 Ha, as we expected very few moose in these areas (Demarchi 2000, Walker et al. 2006). Stratum 3 was defined as the low elevation wintering area in Mount Robson Provincial Park, including wintering habitat in a wide low-angle regenerating burn and meadow complex along the Moose River to 1500 m, based on discussions with BC Parks staff. Stratum 3 was 195 km$^2$ and conducted as a total count, and not stratified or randomly sampled.

We overlaid a 3x3 km (9 km$^2$) grid over the survey area to define blocks with varying amounts of S1 and S2 (Figure 1 and Figure 2). We arbitrarily combined adjacent blocks into sample units (SUs) to ensure that each SU contained 4-9 km$^2$ of S1 for S1 blocks and 5-9 km$^2$ of S2 for the S2 blocks, to increase the probability of detecting at least one moose in each SU (Heard et al. 2008). This resulted in two separate grid layers with adequate areas of S1 or S2 respectively, from which we selected SUs to survey all S1 or all S2. We randomly selected 50 of 197 S1 SUs and 34 of 280 S2 SUs. This was the equivalent of 25.6% of S1 SUs (26.0% of S1 area) and 11.8% S2 SUs (12.6% of S2 area). We used ArcGIS 10.6.1 (ESRI, Redlands, CA) for manipulation and analysis of spatial data. The distribution of S2 and S1 area in the selected blocks was representative of the distribution of S1 and S2 area in the available blocks, suggesting a representative sample (Figure 2).

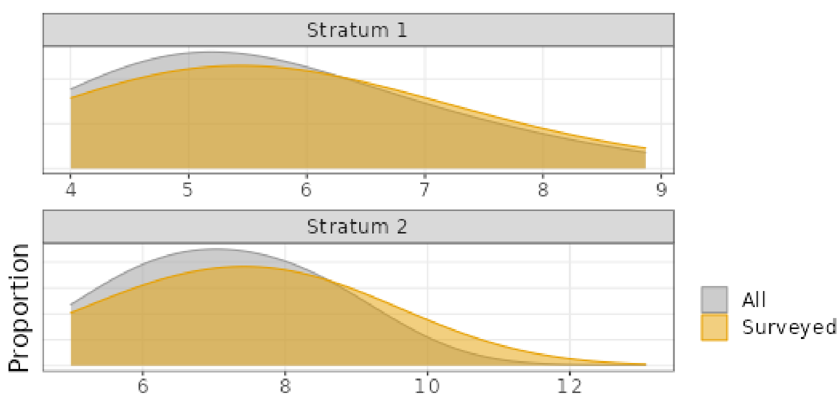


**Figure 2. Distribution of selected sample unit areas for S1 and S2 blocks compared to the distribution of S1 and S2 areas in all sample units.**

We flew the survey with one crew of four (pilot, navigator, and two observers) in a Bell 206 helicopter with bubble windows searching each strata type within the randomly selected SUs. We used Avenza PDF Maps on GPS-enabled iPads for real-time navigation and flew transects at 200-400 m spacing depending on vegetation cover. Once a moose was observed, we circled to determine age-classes and sex (cow, calf, yearling bull, subprime bull, prime bull, senior bull). Calves were identified by their size and short faces; bulls by antlers, bell morphology and lack of cow features; and cows by the presence of a white vulva patch, bell morphology, and facial colouration (Timmermann and Buss 1998). Yearling bulls were additionally classified by antler points to assess the proportion of spike-fork bulls (at least one antler with 1 or 2 tines only). For each observation we recorded the vegetation cover to the nearest 5% within a 9-m radius of where the first moose in the group was seen (Unsworth et al. 1998). Each location was recorded on a handheld GPS unit. We circled any moose close to SU and stratum boundaries and checked the location in ArcGIS 10.6.1 post-survey to assess whether it would be included in the analysis and removed observations that fell outside the survey area (Figure 3).

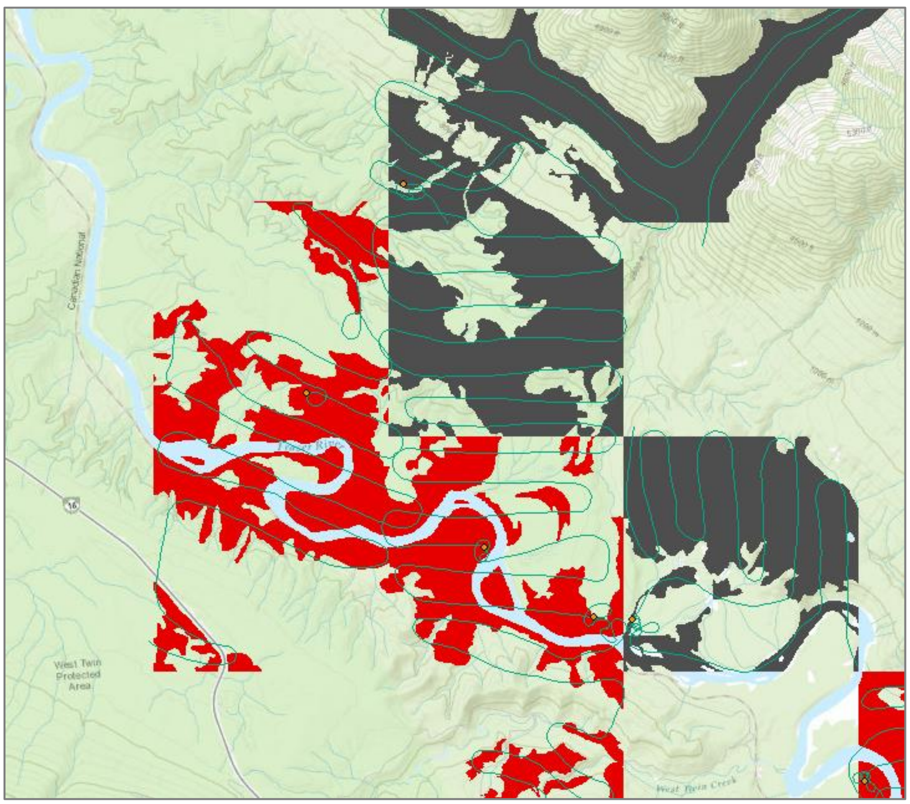


**Figure 3. Map showing flightlines (green) and moose observations (orange points) over selected S1 (red) and S2 (grey) sample units.**

## Data Analysis

We corrected for sightability bias by using vegetation cover estimates for each stratum and a sightability correction factor (SCF; Fieberg, 2012) based on the specific detection probability (Quayle et al. 2001) for 5 vegetation cover classes (Table 1; Anderson and Lindzey 1996).

Table 1. Vegetation cover classes, range of vegetation cover (%), detection probability, and sightability correction factor (Quayle et al. 2001, Fieberg 2012, Schwartz 2022) that were used to extrapolate population estimates of moose in the Robson Valley survey area, January 2023.

| Vegetation Cover Class (VCC) | Vegetation Cover (%) | Detection Probability (DP) | Sightability Correction Factor |
|---|---|---|---|
| 1 | 0-20 | 0.933 | 1.06 |
| 2 | 21-40 | 0.740 | 1.33 |
| 3 | 41-60 | 0.368 | 2.64 |
| 4 | 61-80 | 0.107 | 8.17 |
| 5 | 81-100 | 0.024 | 29.08 |

Moose density, abundance, and demographics (calves and bulls per 100 cows) were estimated using *MoosePopR_DomStrat* (mean per area estimator) within *SightabilityModel* Package using program R 4.2.2 (R Core Team 2021). Standard errors were estimated using bootstrapping to account for the uncertainty in the sightability model and for the multiple measurements in multiple domains on the same unit (Schwarz 2022).

If different sex/age classes inhabit different vegetation cover types with different detection probabilities, bias can be introduced into the calf: cow and bull: cow ratios (Steinhorst and Samuel 1989). We tested whether there was a difference in the cover used by cows with calves (maternal cows), cows without calves (lone cows), and bulls. We also tested whether vegetation cover used by moose differed between S1 and S2. We used a single factor ANOVA (Zar 1999) with $\alpha = 0.05$.

# Results

## Search Effort and Survey Conditions

We completed the survey in 41.6 hours on survey (50 hours including ferry time) between January 16-22, 2023 (Appendix 1). We based the crew and helicopter out of Valemount for the southeastern portion of the study area, then based in McBride for the northwest. We averaged 22.8 minutes per SU where S1 was sampled and 24.0 minutes per SU where S2 was sampled. This equated to 4.0 ± SE 1.3 min/km$^2$ for SUs where S1 was flown (n=50) and 3.3 ± SE 1.6 min/km$^2$ for SUs where S2 was flown (n=33).

Temperatures were between -9°C and 4°C with clear to overcast conditions, usually broken or scattered cloud, and calm winds to 40 km/h. Some localized fog was present over lakes and in valleys in the mornings, generally clearing by afternoon. Snow coverage was near complete for most of the survey but could be patchy to absent in some agricultural fields. Snow depth was shallower than normal and varied by elevation, but few tracks or moose were seen above 1200 m on ferry flights or during the MRPP total count, except for the Moose River Valley where moose were observed up to 1400 m.

## Moose Abundance and Density

We observed 258 in survey blocks and recorded a sightability-corrected estimate of 1049 ± SE 135 moose with an overall density of 0.32 moose/km$^2$ (Table 2) over the 3272.2 km$^2$ survey area. We counted 57 moose in the MRPP total count area, most of which were bulls (67%, Table 3). Moose were generally not seen in thick cover, even in S2 areas, with mean SCF of 1.09 overall, 1.07 in the MRPP total count area, 1.08 in S1, and 1.12 in S2.

**Table 2. Estimated density and abundance of moose in Robson Valley strata, January 2023.**

| | Robson Valley 2022-23 | | | |
|---|---|---|---|---|
| | MRPP Total Count | Stratum 1 | Stratum 2 | Total |
| No. of Sample Units Surveyed | 1 | 50 | 34 | 85 |
| No. of Sample Units in Stratum | 1 | 195 | 281 | 477 |
| Area of Sample Units Surveyed ($km^2$) | 194.9 | 283.3 | 248.85 | 728.3 |
| Area of Entire Stratum ($km^2$) | 194.9 | 1087.9 | 1989.4 | 3272.2 |
| Moose Observed | 57 | 168 | 33 | 258 |
| Mean Sightability Correction Factor | 1.07 | | | |
| Corrected Density (moose/ $km^2$) | 0.31 | 0.65 | 0.15 | 0.32 |
| Population Estimate | 59.6 | 690.5 | 299.2 | 1049.3 |
| Standard Error of Population Estimate | 2.7 | 91.8 | 97 | 134.8 |
| Coefficient of Variation of Population Estimate (%) | 0.05 | 0.14 | 0.31 | 0.13 |

**Table 3. Estimated demographic ratios of moose in Robson Valley, January 2023.**

| Survey Area | Bulls:100 cows ±SE | Bulls:100 cows 90% CI | Calves:100 cows ±SE | Calves:100 cows 90% CI |
|---|---|---|---|---|
| WMUs 7-1 to 5 | 120 ± 18 | 84-155 | 32 ± 5 | 23-42 |
| WMUs 7-2 to 7-5 | 98 ± 16 | 65-128 | 33 ± 5 | 25-44 |
| MRPP (7-1) | 250 ± 19 | 219-281 | 28 ± 3 | 22-33 |

We classified 123 bull moose in 7-1 to 7-5, of which 12 were yearlings, 38 were sub-prime bulls, 3 were prime bulls, and 70 were antlerless. Although only 9.7% of bulls were classified as yearlings, several had only one antler and one was specifically identified as antlerless; it is likely that many yearlings were antlerless and the proportion of yearling bulls may be higher than what we recorded from the 43% of bulls that still had antlers. We observed 7 yearlings that were spike-forks (at least one antler with 1 or 2 tines) but could not classify yearlings missing one or both antlers as meeting the spike-fork definition. The low proportion of bulls with antlers makes determination of bull proportions from this survey likely biased and unreliable.

## Elk

We recorded all elk observations and used ferry flights to search agricultural areas and river valleys likely to have elk present. In most cases, we could follow tracks, beds, and cratering to locate the elk, but did note one tracked up area near Tete Jaune Cache where we did not track cratering to a group of elk, either because they remained out of sight or because the tracks were made by a group that were observed several kilometers away. Elk were classified by size and antler configuration as cows, calves, spike bulls (yearlings), raghorns (immature bulls generally 2-4 years old with 2-4 tines per antler), and mature bulls

(5 or 6 tines per antler). Observations of 13 groups of elk provided a minimum total count of 311 elk for the Robson Valley (198 cows, 71 calves, 15 spike bulls, 9 raghorn bulls, 9 mature bulls). No elk were seen in 7-1. The calf: cow ratio was 36 calves:100 cows (30-41 calves:100 cows 95%CI). The bull: cow ratio was 20 bulls:100 cows (3-33 bulls:100 cows 95%CI). The actual population will be higher given that we did not search the entire valley and focused on areas with a high likelihood of detection. Applying a bootstrap to estimate variance on the minimum count provides a 95% CI of 112-511 elk.

### Incidental Observations

We also recorded one wolverine running down a road along the Kinbasket Reservoir, one red fox, and a pack of 3 wolves near the mouth of the Rausch River. We saw several coyotes but did not record them. We saw two groups of mountain goats (3 and 5 goats) in low broken cliffs. We also saw 4 adult caribou near the MRPP boundary south of Yellowhead Lake, just west of locations from collared individuals in the Tonquin herd in Jasper National Park. We saw 24 mule deer and 68 white-tailed deer but did not classify most groups to age/sex.

## Discussion

### Moose Population Trends

The moose density we recorded on this survey (0.32 moose/km$^2$) is similar to densities recorded in other mountainous areas of the Omineca Region (North Williston 0.34 moose/km$^2$, Scheideman and Anderson 2020; Central Omineca 0.29 moose/km$^2$, Anderson et al. 2022). The density observed on this survey was substantially higher than the Hart South survey area, also in the Upper Fraser GMZ (0.14 moose/km$^2$, Sowers et al. 2020). Although ungulate surveys have been completed in parts of the survey area previously, the objectives have been distribution, habitat selection, and relative density of ungulates and prioritization of areas for enhancement, not abundance. Density estimates were provided for some of the surveys, but inconsistent survey timing makes it difficult to interpret trend. WMU 7-1 (Mount Robson) was included as a separate total count; this provides BC Parks with baseline monitoring information to meet their objectives, and further informs GMZ-level moose management despite no open moose hunting season in 7-1.

Surveys flown in March 1991 were the first phase of strategic planning for what is now the Columbia Basin Fish and Wildlife Compensation Program. The March 1991 surveys covered subalpine caribou habitat as well as low elevation valleys from Canal Flats south of Invermere to the Morkill River west of McBride in under 100 hours of helicopter time, averaging <1 min/km$^2$ in survey intensity. The authors note that density estimates are compromised by variable sightability and survey effort among survey blocks. The February 1993 surveys in the Robson Valley undertaken by Ministry of Environment and the Mica Wildlife Compensation Program were conducted between the Kinbasket Reservoir and McBride to determine habitat selection and identify priority areas for enhancement, not to determine abundance or density. The need for a survey covering more blocks and incorporating stratification was highlighted in the conclusions of the report.

The 1993 Large Mammal Monitoring Plan was revised as a comprehensive program to monitor ungulate distribution, occurrence, and density. The 1994-1997 surveys focused on assessing use of identified enhancement areas and locating other candidate areas for ungulate enhancement. Surveys covered many of the same blocks identified in 1991 and with more systematic transect coverage to estimate relative density, but abundance was still not an objective of the work. Surveys in the Robson Valley were flown in March 1994 (although only part of the area with only 5 moose observed), January 1996, and February 1997. The difference in reported densities in 1996 (0.65 moose/$km^2$) and 1997 (0.34 moose/$km^2$) was not significant but may be due to the difference in survey timing.

**Table 4. Demographic ratios for moose based on surveys in parts of WMUs 7-02 to 7-05, 1991-present. Number observed informs confidence in demographic ratios but is not an abundance estimate.**

| Survey Area | Survey Date | Bulls: 100 Cows | Calves: 100 Cows | Number Observed |
|---|---|---|---|---|
| WMUs 7-1 to 7-5 | Mar 1991 | 57 | 40 | 365 |
| Kinbasket to McBride | Feb 1993 | 52 | 39 | 339 |
| Kinbasket to McBride | Mar 1994 | | | 5 |
| Kinbasket to McBride | Jan 1996 | 57 | 45 | 382 |
| Kinbasket to McBride | Feb 1997 | | | 106 |
| East Kinbasket | Jan 2005 | | | 18 |
| West Kinbasket | Feb 2006 | | | 28 |
| Kinbasket to McBride | 2000 | 69 | 39 | 357 |
| Kinbasket to McBride | 2003 | 39 | 39 | 286 |
| Kinbasket to McBride | Jan 2013 | 82 | 23 | 206 |
| WMUs 7-2 to 7-5 | Jan 2023 | 98 | 33 | 201 |
| WMUs 7-1 to 7-5 | Jan 2023 | 120 | 32 | 258 |
| Mount Robson Park | Jan 2023 | 250 | 28 | 57 |

In January 2005 and February 2006, the ungulate monitoring program flew the Kinbasket Reservoir (including the Canoe Reach in Region 7A), on the east side from Kicking Horse River to Bulldog Creek in 2005 and the west side from Donald to Valemount in 2006. Stratified block surveys were completed by FLNRO and CBFWCP in January 2013 over the same blocks flown in 2000 and 2003. Deer were tallied but not classified.

The density estimate from this survey will provide a baseline for comparison moving forward. MRPP was included in the overall estimates for this survey but sampled separately, as there is no licensed hunting in the park and it may not be surveyed with the same intensity of areas with moose harvest. However, the predominance of bulls in MRPP in winter despite regular observations of cows and calves BC Parks staff in the summer suggests that moose in the park are part of a larger population. Cows and calves likely move out of this area in the winter, either west into BC or east into Alberta. Inclusion of MRPP in moose population surveys will better inform GMZ-level objectives, despite no licensed moose harvest taking place in MRPP.

## Moose Harvest

Moose management in the Omineca Region emphasizes sustainable and accessible harvesting opportunities to First Nations, resident hunters, and the guide outfitting industry. Following widespread moose declines in the 2000s, licensed harvest opportunities for moose in the Omineca Region were substantially reduced. Cow harvest was reduced by 90% and restricted to one limited entry hunt (LEH) authorization per MU in 2016. The moose calf general open season was shortened and restricted to youth and seniors in 2014 and closed in 2017. Bull moose allocation was reduced by 12% in parts of the Omineca Region for 2017-2021, including in the survey area, and reduced again by about 8% for 2022-2027. In addition to the more restrictive harvest opportunities, there are access restrictions in the Morkill River valley prohibiting the use of motorized vehicles for hunting.

Moose harvest is reported at the WMU scale, and the survey area includes the low elevation areas of WMUs 7-1 (no harvest), 7-2, 7-3, 7-4, and 7-5. We calculate harvest rates by applying the S1 and S2 densities to the area of S1 and S2 in each WMU during the allocation process, although without having had these densities previously, harvest trends were used to assess the likely population trend for moose in the Upper Fraser GMZ. WMUs 7-17 and 7-18, also part of the Upper Fraser GMZ, were last flown in January 2020 and not included here (Sowers et al. 2020).

Licensed hunter harvest in the survey area has declined over the last decade (data available to 2020), reaching a low in 2017 with a coincident spike in hunter effort (Figure 4). The number of moose hunters in the survey area has declined steadily over the same timeframe (Figure 4) from about 650 resident hunters in 2011 to about 450 in 2020. Non-resident hunters have also declined from 29 in 2011 to 4 in 2017, 2018, and 2019. The non-resident harvest has been less than 5 moose since 2012 and the non-resident hunter days has averaged less than a month since 2014. The average resident harvest from 2016-2020 was 36 moose per year, although in previous years it was as high as 120-140 moose per year. Residents spend on average about 4300 hunter-days per year hunting moose in the survey area.

The sustainable harvest rate of a moose population varies depending on predation pressure and selectivity of harvest, from about 5-10% when most harvest is bulls and predators are present, to as high as 25% in a predator-free system (Crête 1987, Fryxell et al. 1988, Gasaway et al. 1992, Hatter 1999, Heard et al. 1999). Licensed moose harvest 2007-2011 averaged 126 moose/year while lower harvests 2016-2020 averaged 36 moose/year. With bulls making up 48% of the moose population (post-hunt), and a population estimate of 1049 moose (including 7-1), we expect about 500 bulls in the survey area and recent harvest rates to be around 7% of the bulls or less than 3.5% of the total moose population. The average harvest over the last 3 years is generally below other jurisdictions with stable to increasing populations (Caikoski 2018) and is at or below the recommended maximum sustainable harvest rate (10-11% unselective of sex) provincially, especially given that the licensed harvest is almost entirely bulls (BC FLNRO 2015). The high bull ratios further suggest that current harvest rates are sustainable in the Robson Valley.

Licensed harvest varies vary by WMU, from zero in 7-1 to an average of 12-13 moose annually in 7-3 and 7-5, 9 moose/year in 7-4, and 5 moose/year in 7-2 (from 2016-2020). Calculating harvest rates at the WMU level, rather than the GMZ level, involves applying a fall harvest metric to a wintering moose population, and the moose population may not be distributed at the estimated winter densities in the WMUs from which moose are harvested in the fall. We are also calculating harvest rate on the post-harvest population, so the harvest rate reported here is slightly higher than if it had been reported based on the pre-harvest population. Managing at the GMZ scale is intended to mitigate error introduced by seasonal distribution shifts. Actual harvest rates are greater than our presented estimates because the reported harvest only accounts for licensed harvest. First Nations harvesting moose on their traditional territories are not required to obtain a license or to report their harvest. More localized changes in moose distribution and behaviour or hunter access and pressure will be factors affecting harvester success at a smaller scale than the overall moose population trend and need to be considered in harvest management decisions.

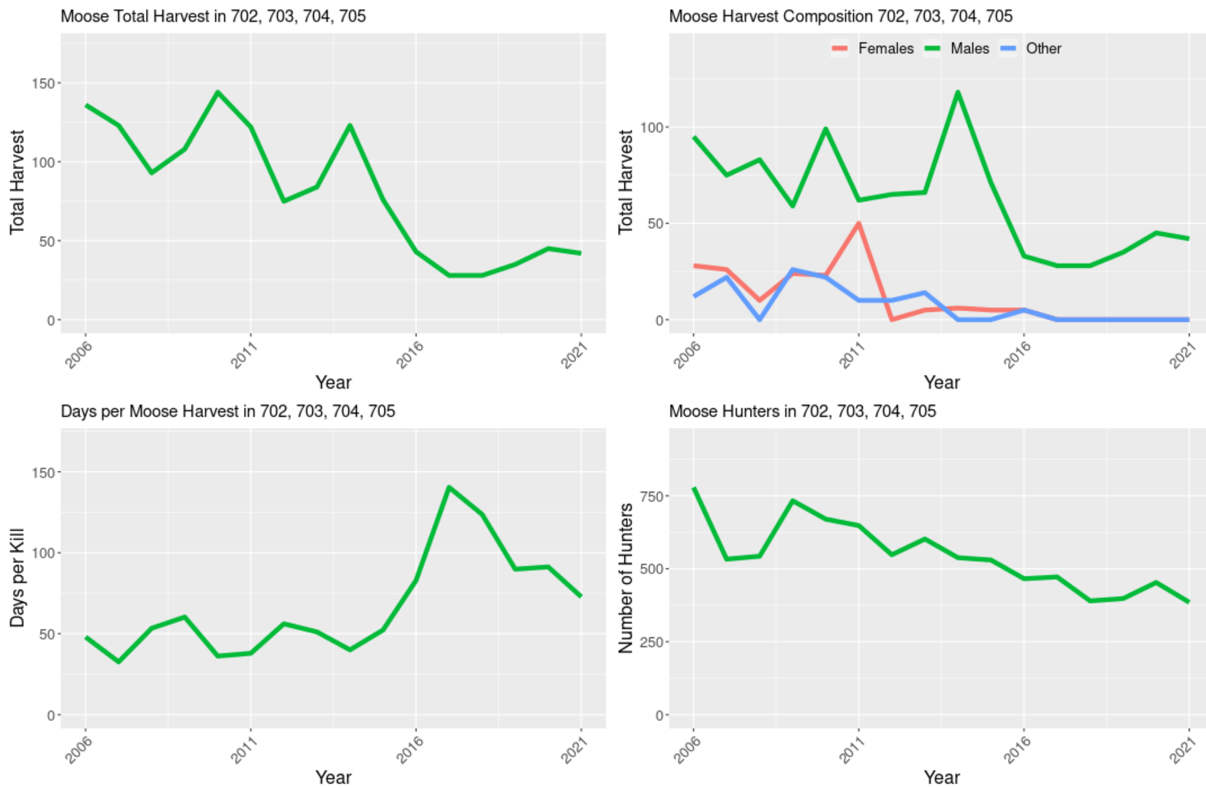


**Figure 4. Moose harvest metrics for the Robson Valley from 2006-2021 including total moose harvest (top left), harvest composition by sex and age (top right), hunter effort as days per kill (bottom left) and number of hunters (bottom right).**

## Elk population trends

Elk surveys have not been consistently flown in the Robson Valley and there is no comparable data to establish a trend; similarly, the minimum count obtained on this survey is not a population estimate for trend determination, as the complete coverage of the survey area needed for a total count survey was not possible. The patchy distribution of elk in the valley and the inconsistent survey areas on previous surveys further complicate assessment of overall trend. A low minimum count would not necessarily have precipitated management action beyond conducting a more thorough abundance estimate, however, a high minimum count is sufficient to ensure that current harvest is sustainable. As the primary objective of elk monitoring on this survey was harvest sustainability, and the minimum count suggests sustainable harvest, the objective was met without the need for additional survey effort.

In 2013, after concerns of elk population growth and damages to agricultural land and stored crops, Provincial wildlife biologists GPS collared 15 cow elk between Crescent Spur and Tete Jaune Cache. Survival was >90% annually, and none of the elk left the valley bottom during the 3 years they were monitored. The survey boundaries and objective for this survey were based on the area frequented by these collared cows between 2013 and 2015. During this time, it was estimated that approximately 400 elk were present between Crescent Spur and Tete Jaune Cache. The minimum count of 311 elk observed on this survey would suggest the elk population has been stable over the last decade. Local observations also suggest that elk seasonal distribution has not changed in recent years, potentially due to selection of easily accessible forage on and adjacent to private land. Elsewhere in the Omineca Region, groups of more than 100 elk are frequently observed when elk group up to exploit these resources.

**Table 5. Demographic ratios for elk based on surveys in parts of WMUs 7-02 to 7-05, 1991-present. 2014 observations were associated with scouting flights for elk capture and collaring. Number observed informs confidence in demographic ratios but is not an abundance estimate.**

| Survey Area | Survey Date | Bulls: 100 Cows | Calves: 100 Cows | Number Observed |
|---|---|---|---|---|
| WMUs 7-1 to 7-5 | Mar 1991 | | | 0 |
| Kinbasket to Fraser, Holmes | Jan 1996 | 29 | 22 | 87 |
| East Kinbasket | Jan 2005 | | | 0 |
| West Kinbasket | Feb 2006 | | | 1 |
| Robson | Feb 2012 | | | 51 |
| Kinbasket to McBride | Jan 2013 | 31 | 22 | 75 |
| Crescent Spur to Dunster | Feb 2014 | | | 214 (approx.) |
| Crescent Spur to Dunster | Mar 2015 | | | 84 |
| WMUs 7-1 to 7-5 | Jan 2023 | 20 | 36 | 311 |

## Elk Harvest

There was a very limited LEH for elk in the Robson Valley, during the 1990s, and beginning in 2003 a general open season for 6-point bull elk was implemented. In 2006, an any sex/any age LEH was opened in the Robson Valley, which was then expanded in 2011 to three LEH seasons (Nov 15-Dec 14, Dec 15-Jan 14, Jan 15-Feb 14) for antlerless elk on private land in 7-2 to 7-5. The intent of the added opportunity was to reduce hay depredation and haze elk off private lands sustaining elk damages. Since then, approximately 25% of LEH authorizations are successfully utilized by hunters. Bull elk harvest, antlerless elk harvest, hunter effort and the number of hunters all appear to be relatively stable over the last decade, another indication the population has been relatively stable at around 400 elk in the valley. The main concern heard from resident hunters in the Robson Valley has been the purchase of large tracts of land by owners unwilling to allow resident hunter access and who actively dissuade resident hunters from hunting near their properties.

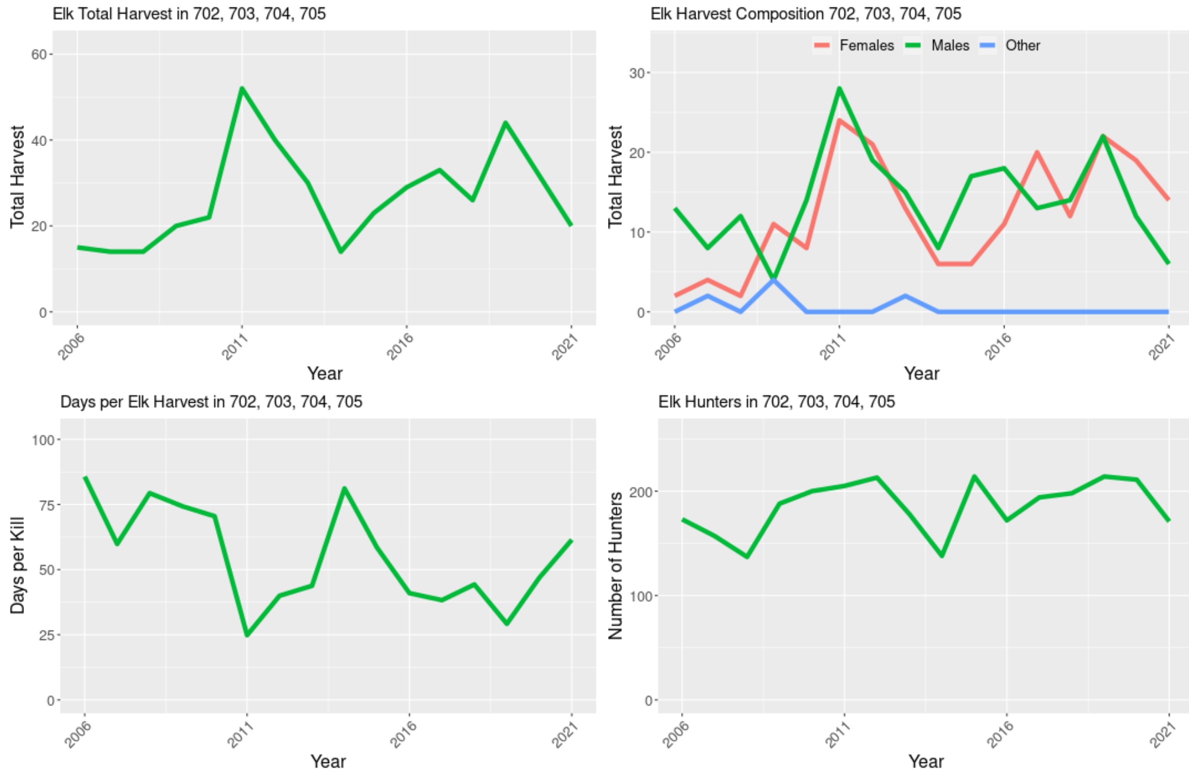


**Figure 5. Elk harvest metrics for the Robson Valley from 2006-2021 including total moose harvest (top left), harvest composition by sex and age (top right), hunter effort as days per kill (bottom left) and number of hunters (bottom right).**

## Deer Population Trends

Deer are difficult to detect on aerial surveys, and their low probability of detection was highlighted in previous surveys in the Robson Valley as well. Only 87 mule deer and 9 white-tailed deer were observed on the 3 surveys from 1994-1997 and most adults were not classified to sex. Surveys in 2005 detected 4 white-tailed deer and 27 mule deer, and surveys in 2006 detected 26 white-tailed deer (2006 was locally regarded as a severe winter that resulted in a crash in mule deer numbers across the region). These sample sizes were insufficient to calculate reliable demographic ratios for the area. During the survey in 2023, we saw 24 mule deer and 68 white-tailed deer, and did not classify all groups by sex or age. A more interesting comparison may be the relative abundance of mule deer and white-tailed deer in the valley between the mid 1990s and the current survey, with a shift from almost ten times more mule deer than white-tailed deer, to almost three times more white-tailed deer than mule deer. Sample sizes are small and the distribution of blocks and observations would be expected to influence the relative abundance of mule deer and white-tailed deer, but considering mule deer declines across interior BC and anecdotally expanding white-tailed deer populations in the Omineca Region, the shift in relative abundance may not be entirely an artefact of survey effort. Harvest data also suggests substantial declining mule deer populations while white-tailed deer harvest has remained stable with a notable peak in 2009.

## Deer Harvest

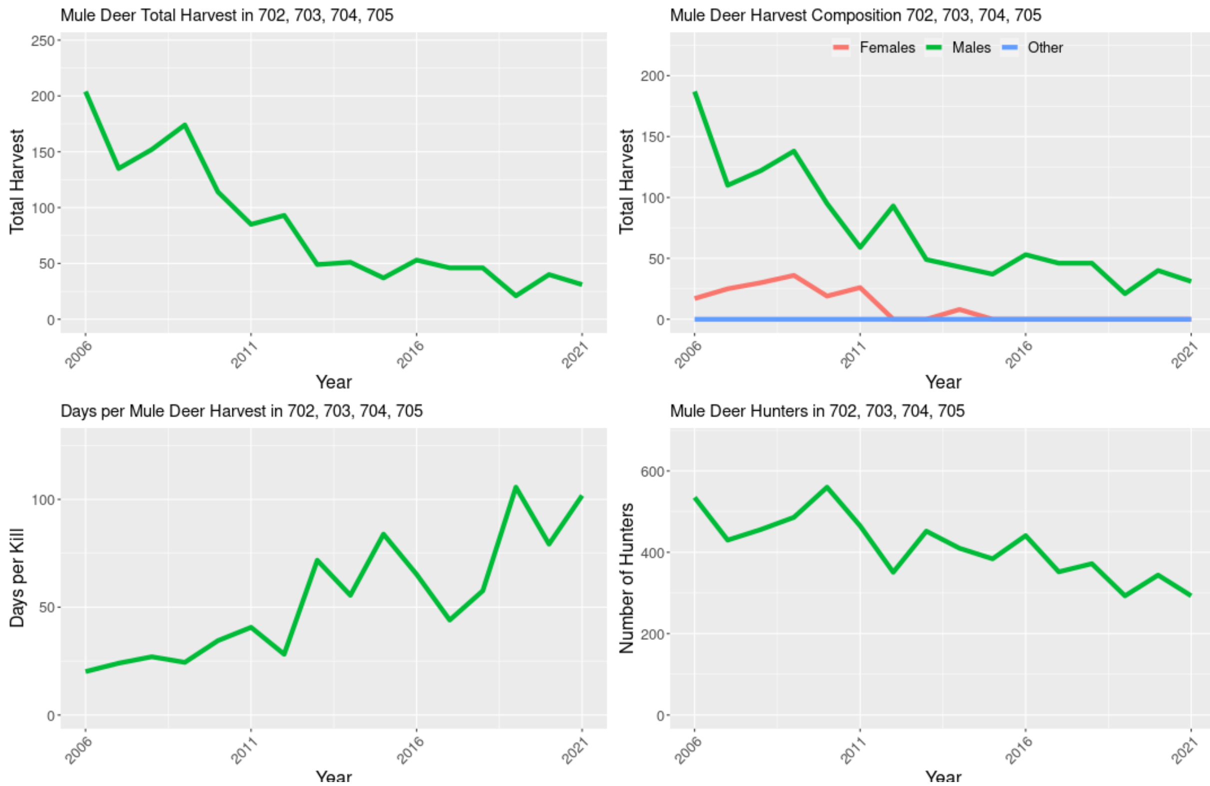


**Figure 6. Mule deer harvest metrics for the Robson Valley from 2006-2021 including total moose harvest (top left), harvest composition by sex and age (top right), hunter effort as days per kill (bottom left) and number of hunters (bottom right).**

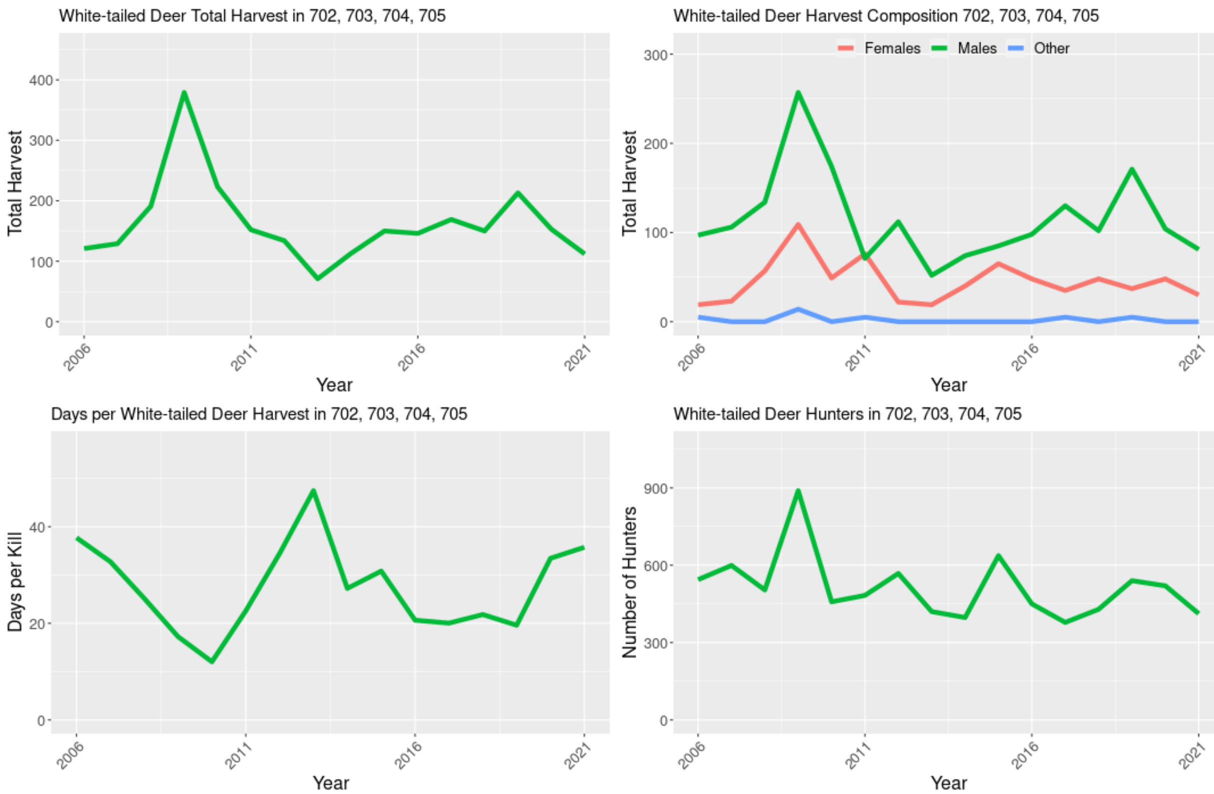


**Figure 7. White-tailed deer harvest metrics for the Robson Valley from 2006-2021 including total moose harvest (top left), harvest composition by sex and age (top right), hunter effort as days per kill (bottom left) and number of hunters (bottom right).**

# Conclusions and recommendations

Results from this survey (0.32 moose/km$^2$) suggest that moose densities are comparable to other mountainous areas in the Omineca Region but without reliable density estimates from previous surveys, we are unable to determine population trend for the Robson Valley. Results from this survey should form the baseline for long-term monitoring. A SRB survey, designed to be consistent with this survey, should be repeated in 5 years to provide an estimate of moose population trend for the survey area. Licensed harvest (almost entirely bulls) is below the recommended maximum harvest rate for the survey area and bull ratios remain high, with bulls making up almost half the population. Hunter success has been stable to increasing, and consistently high bull ratios suggest current harvest management is adequate at the population scale. Calf ratios were adequate for mid-winter, although calves incur substantial mortality in the late winter and spring, and calf recruitment is expected to be variable.

The minimum count of elk, known to be an underestimate of the actual population, is adequate to support the number of LEH authorizations to address conflict with agricultural producers without concern for sustainable elk populations in the Robson Valley. Results from the 2023 survey suggest that current harvest is sustainable.

White-tailed deer have evidently increased in relative abundance compared to mule deer since the 1990s and early 2000s, and trends in white-tailed deer and mule deer populations (and harvest opportunities) should be further investigated.

## Acknowledgements

Funding for this survey was provided by Together for Wildlife (T4W) Phase 1 Inventory and Monitoring and from BC Parks for the Mount Robson total count. We thank Greg Goodison at Ascent Helicopters for his safe and skillful flying and enthusiasm for wildlife work (and Dan for our remote fueling). We also thank our crew of observers – Amanda Celesta (Simpcw Resources Group Inc.), Tina Donald (Simpcw Council), and Elliot Ingles (BC Parks). We look forward to working together on upcoming projects and continuing to discuss moose and moose management in the Omineca Region.

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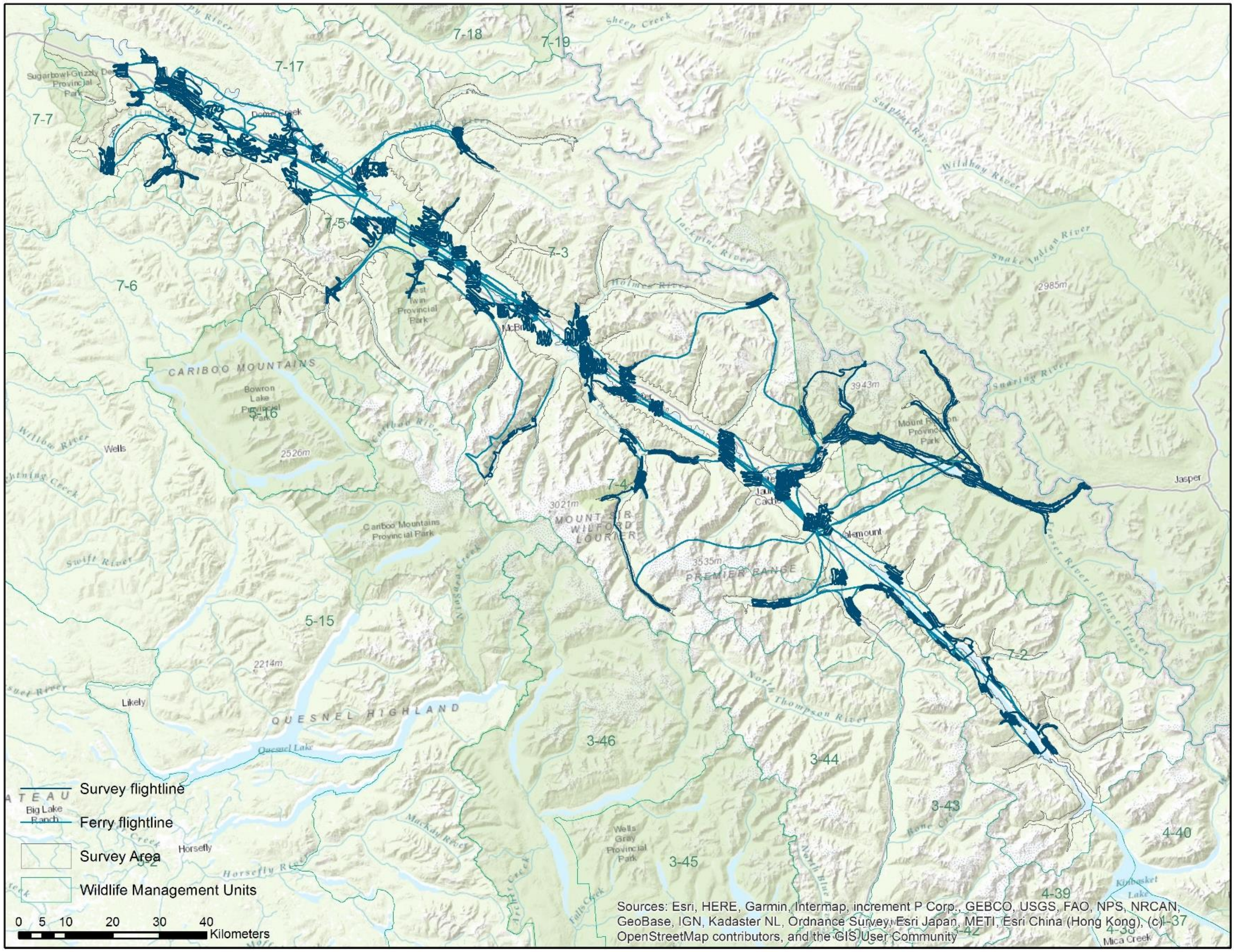
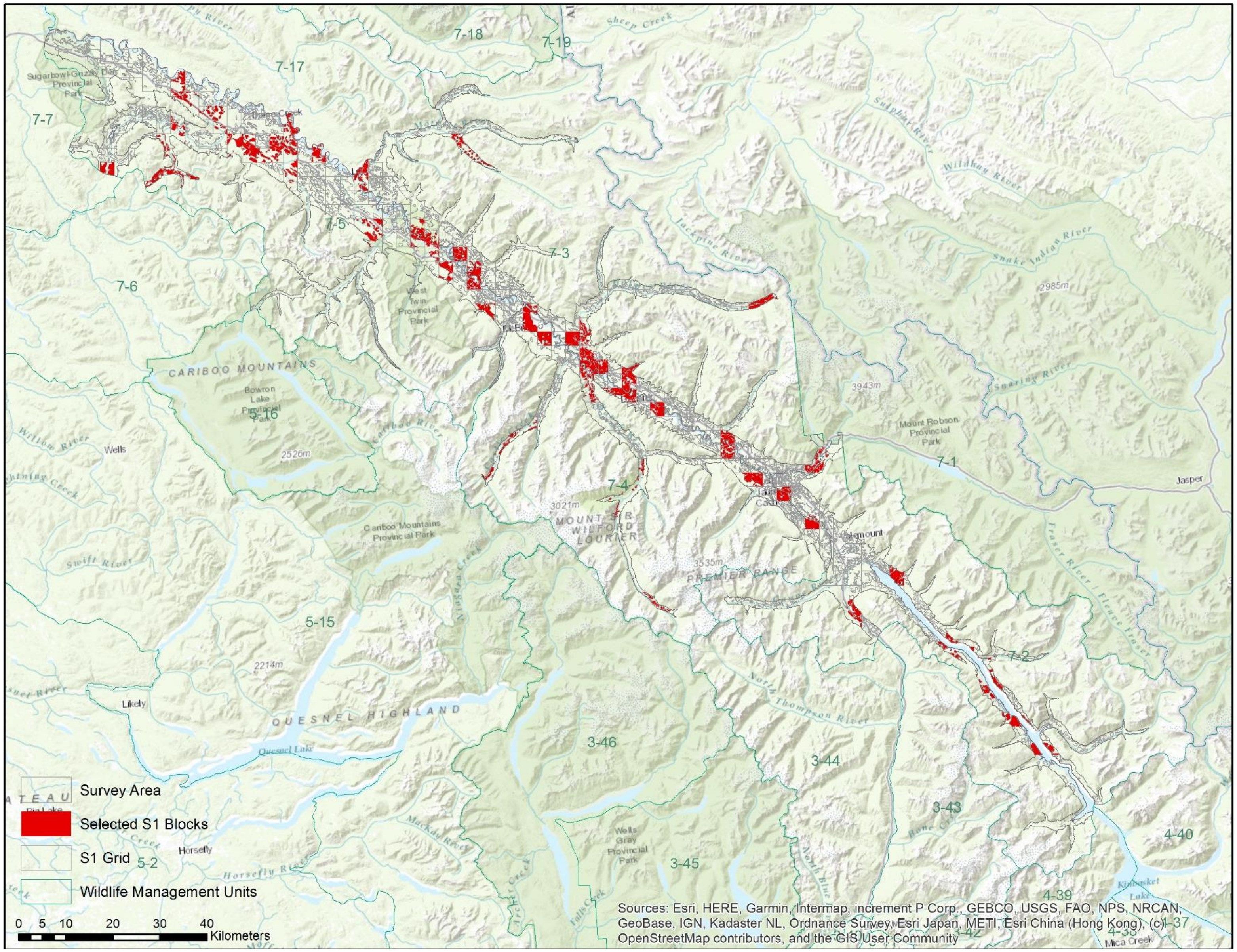
Appendix 1. Overview of survey flights and crews on the Robson Valley moose survey, January 16-22, 2023.

| **Date** | **Aircraft** | **Pilot** | **Navigator** | **Left Observer** | **Right Observer** | **Conditions** |
|---|---|---|---|---|---|---|
| 16-Jan-23 | WSW | Greg Goodison | Morgan Anderson | Amanda Celesta | Matt Scheideman | Overcast 3°C patchy fog |
| 17-Jan-23 | WSW | Greg Goodison | Morgan Anderson | Amanda Celesta | Matt Scheideman | Sunny, scattered clouds 0°C |
| 18-Jan-23 | WSW | Greg Goodison | Matt Scheideman | Tina Donald | Amanda Celesta | Overcast 0°C |
| 19-Jan-23 | WSW | Greg Goodison | Morgan Anderson | Amanda Celesta | Elliot Ingles | Sunny -9°C becoming overcast |
| 20-Jan-23 | WSW | Greg Goodison | Morgan Anderson | Amanda Celesta | Matt Scheideman | Overcast -4°C light snow |
| 21-Jan-23 | WSW | Greg Goodison | Morgan Anderson | Amanda Celesta | Matt Scheideman | Overcast 0°C light snow |
| 22-Jan-23 | WSW | Greg Goodison | Morgan Anderson | Amanda Celesta | Matt Scheideman | Overcast -1°C |

Appendix 2. Survey coverage over selected blocks in the Robson Valley moose survey, January 16-22, 2023.




Survey Area
Selected S1 Blocks
S1 Grid
Wildlife Management Units
0 5 10 20 30 40
Kilometers
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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3-43
3-45
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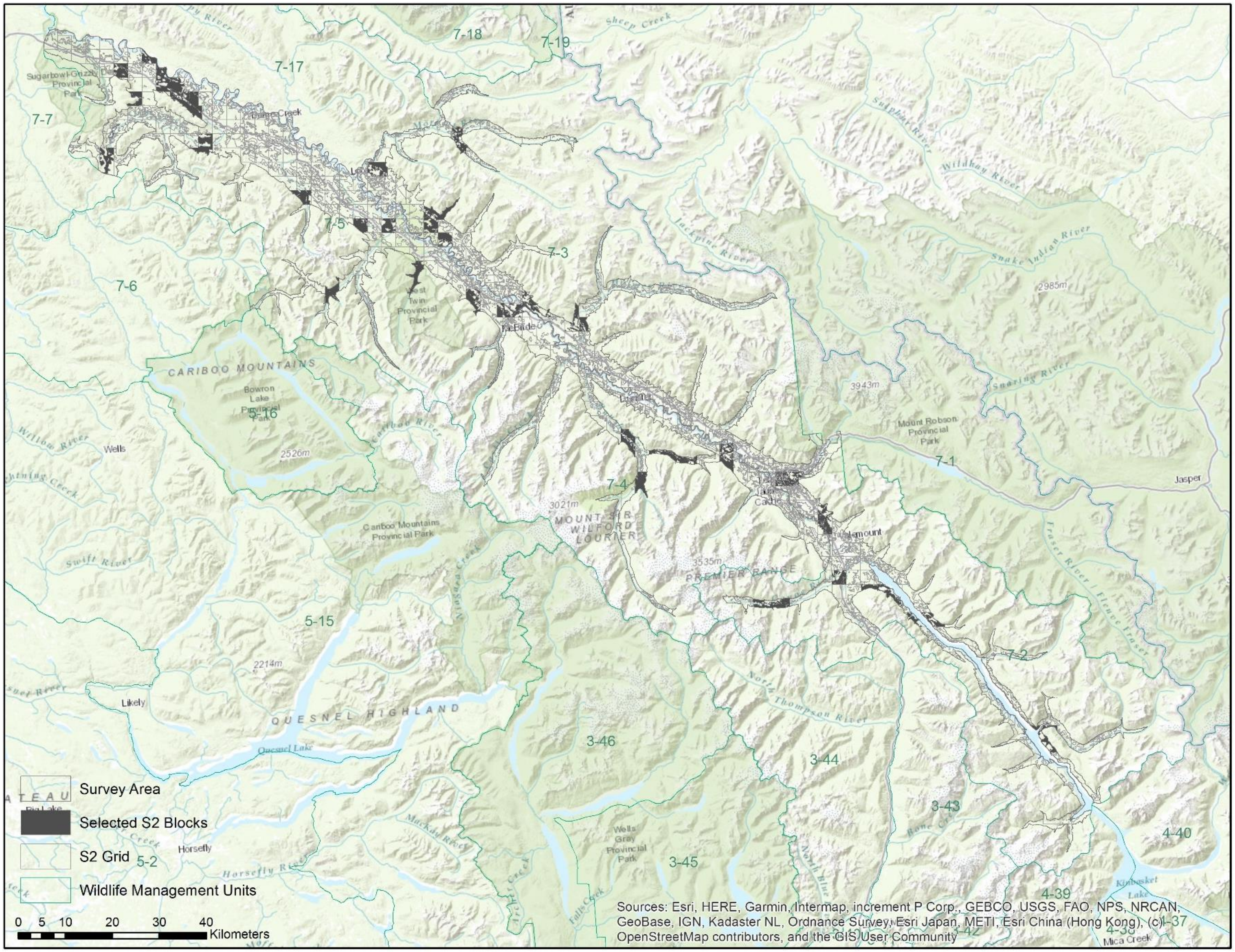
4-39
CARIBOO MOUNTAINS
QUESNEL HIGHLAND
PREMIER RANGE
Mount Robson Provincial Park
Cariboo Mountains Provincial Park
Wells Gray Provincial Park
Bowron Lake Provincial Park
West Twin Provincial Park
Wells
Likely
Horsefly
Jasper
Valemount
Mica Creek


Survey Area
Selected S2 Blocks
S2 Grid
Wildlife Management Units
0 5 10 20 30 40 Kilometers
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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3-44
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4-40
4-39
CARIBOO MOUNTAINS
QUESNEL HIGHLAND
PREMIER RANGE
Sugarbowl-Grizzly Provincial Park
Bowron Lake Provincial Park
Cariboo Mountains Provincial Park
West Twin Provincial Park
Mount Robson Provincial Park
Wells Gray Provincial Park
Wells
Likely
Horsefly
Jasper
McBride
Valemount
Mica Creek
Quesnel Lake
Sheep Creek
Jackpine River
Snake Indian River
Smoky River
North Thompson River
Horsefly River
Swift River
Willow River
2985m
3943m
2526m
3021m
3535m
2214m