Yukon

SR-26-02

Klaza Caribou Herd

Population Estimate 2024

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Government of Yukon
Fish and Wildlife Branch
SR-26-02

Authors

Kelsey L. Russell, Kristina Beckmann, Joël Potié, Shawn Taylor

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Copies available from:

Government of Yukon
Fish and Wildlife Branch, V-5
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721
Email: fish.wildlife@yukon.ca
Online: www.yukon.ca

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Executive summary

- We conducted a mark-resight population survey on the Klaza caribou herd, located northwest of Carmacks, Yukon, from 15–20 October 2024.
- This work was driven by Section 110 monitoring recommendations from the Yukon Environmental and Socio-Economic Assessment Board (YESAB) for the Coffee Gold Project and associated Charlotte Property, aiming to assess project-level and cumulative effects on the Klaza caribou herd.
- The 2024 estimate of the Klaza caribou herd is 913 caribou (95% confidence interval [CI]: 729–1,146). The previous population estimate in 2012 was 1,179 caribou (95% CI: 952–1,461). Calf recruitment in 2024 was 31 calves/100 cows, above the threshold associated with population stability (20–25 calves/100 cows). The adult sex ratio was 38 bulls/100 cows, above the recommended minimum (30 bulls/100 cows). Caribou were widely distributed in open alpine/subalpine habitats across the core range, including areas near Mount Langham, Mount Cockfield and south of the Klaza River.
- Although the confidence intervals of the 2012 and 2024 population estimates overlap, indicating a population decline is not statistically definitive, the probability the herd declined over this period is 94.6%. The estimated reduction in herd size is 22.6% over approximately 12 years.
- Current calf recruitment and adult sex ratios have improved compared to the 2012–2016 survey period, when both indicators were below the stability thresholds. Recent composition data from 2023 to 2025 suggest the herd is experiencing modest recovery, reflecting a potentially stable or improving trend.
- The smaller estimated herd size in 2024, combined with ongoing regional cumulative impacts across the herd's annual range, and uncertainty regarding mechanisms driving past decline, supports application of a precautionary management approach.
- Ongoing collaboration remains essential to ensure monitoring and management actions are consistent with co-management discussions with First Nations and their priorities for monitoring and stewardship. Integrating population data with upcoming analyses of collar-based movement, habitat use and overlap with natural and anthropogenic disturbance will strengthen adaptive management. Continued annual composition surveys through 2027 and every other year thereafter, along with a subsequent population estimate within the next 5–10 years, are recommended to evaluate long-term population trends and management effectiveness.

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Introduction

The Klaza caribou herd is part of the Northern Mountain population of woodland caribou (*Rangifer tarandus caribou*), which are currently listed as Special Concern under the federal *Species at Risk Act*. The Klaza caribou herd has been studied since the 1980's, with a large-scale baseline assessment of the herd conducted in 2012, which involved industry partners. These studies were driven by concerns from extensive mineral exploration and industrial development in the Klaza herd range that continues today.

The Klaza caribou herd range is an area of interest to multiple First Nations, including Little Salmon/Carmacks First Nation (LSCFN), Selkirk First Nation, Tr'ondëk Hwëch'in, and White River First Nation, all of whom have cultural and historic connections to lands and wildlife in the region. Concerns related to caribou disturbance, habitat integrity and cumulative effects have been raised by multiple First Nations with interests in the area through engagement processes, community-based planning, and regional forums such as the annual Northern Tutchone May Gathering. For example, carefully monitoring and managing the Klaza herd is consistently an objective in the Little Salmon/Carmacks First Nations Community-based Fish and Wildlife Work Plans, with LSCFN expressing concern that continued expansion of exploration projects in the Mt. Nansen and Freegold Road areas has disrupted calving areas and pushed caribou away from their traditional ranges (Little Salmon/Carmacks First Nation Traditional Territory Fish and Wildlife Planning Team, 2019). Additional First Nations have also expressed interest in the Klaza herd through ongoing engagement processes.

In 2022, pursuant to the *Yukon Environmental and Socio-economic Assessment Act (YESAA)*, the governments of Yukon and Canada issued Decision Documents for the Coffee Gold Mine, and the Charlotte Property. Both Decision Documents include YESAA section 110 recommendations pertaining to Klaza Caribou.

From the Coffee Gold Mine Project (YESAB File No. 2017-0211) decision document:

"*Within 5 years of commencing operations, Government of Yukon shall conduct regional surveys, focusing on the interactions between the Fortymile and Klaza caribou herds and the Project. These surveys shall be conducted for the purposes of understanding the direct effects of the Project as well as the effects of the Project's induced development on herd movements and populations, establishing adaptive management thresholds and determining if additional measures are requited should the evidence indicate there are negative project-related effects on caribou, either directly or indirectly*."

From the Class 3 Quartz Exploration - Charlotte Property (YESAB File No. 2021-0188) decision document:

> *"The Government of Yukon shall establish an effects monitoring program to:*
>
> - *Determine caribou population levels and distribution within the Klaza Caribou Herd range (Dawson Range).*
> - *Assess cumulative industrial impacts to the Klaza Caribou Herd to determine whether the KCH can withstand additional disturbances.*
>
> *The monitoring program shall be designed in consultation with LSCFN to determine appropriate methods. Results of monitoring efforts shall be distributed to LSCFN and the Proponent and made publicly available. Monitoring programs shall build on the baseline survey conducted in 2016, and late winter ungulate surveys. Government of Yukon shall develop a plan for the monitoring program within two years of the issuance of this report and shall provide the results of the monitoring program to the Designated Office once completed."*

To address these recommendations, a multi-year monitoring program was established to update the status of the Klaza herd. This monitoring program includes the deployment of 36 GPS collars on Klaza caribou, a mark-resight population estimate survey, and five years of annual fall rut composition surveys. A large-scale camera trapping project was also done in conjunction with this work to support assessment of cumulative effects.

This report summarizes the results of the mark-resight population survey conducted from 15 to 20 October 2024. These results contribute directly to the Section 110 monitoring recommendations described above and provide an updated status and population estimate for the Klaza caribou herd. These findings will inform harvest management and land-use decisions in the area. Further reporting, including an analysis of GPS collar location data, will be produced once the collaring program is completed.

Management and monitoring history

Studies on the Klaza caribou herd were first conducted from 1987–1990 to assess potential impacts of the proposed Casino Trail. These studies included: a collaring program, distribution and movement surveys, a census survey, composition surveys, a range analysis and herd health assessment. The census was conducted in March 1989 using the stratified random quadrat sampling method, producing a population estimate of 441 caribou. Three years of composition surveys were also conducted, which indicated healthy sex ratios and 2 to 3 years of stable calf recruitment (Farnell, Sumanik, McDonald, & Gilroy, 1991). Another population estimate survey was attempted in 1996, using the same method as in 1989, but no formal estimate was produced from this effort.

In 2012, a large-scale inventory program of the Klaza herd was undertaken in response to the rapidly increasing mineral exploration and industrial activity west of Carmacks. At this time, Government of Yukon biologists ranked the Klaza herd as having the highest level of potential conservation concern among Yukon herds, based on anticipated and potential impacts to the herd and its range (Hegel, 2013). As part of this work, GPS collars were deployed on 30 female caribou in winter and fall of 2012, and a mark-resight population estimate survey was conducted in October 2012, yielding an estimate of 1,179 caribou (95% CI = 952–1461). Direct comparison with the previous estimate from 1989 was not possible due to survey methods and spatial extent of survey coverage (Hegel, 2013). The program initiated in 2012 also included composition surveys (2012–2016), habitat modelling, and a range assessment (2016).

The range assessment for the Klaza caribou herd was completed in 2016, summarizing the current habitat, population status, and key risk factors influencing the herd. This assessment was undertaken in response to ongoing management concerns associated with high levels of mineral exploration activity in the Dawson Range (Francis & Nishi, 2016). The assessment outlines key risk factors affecting the Klaza herd, the most major of which being the expansion of seasonal exploration activities into year-round operations with road access. Management recommendations focused on maintaining functional habitat, particularly winter range, reducing human-caused mortalities and mitigating anticipated impacts from future industrial activities (Francis & Nishi, 2016).

The Government of Yukon conducted composition surveys on the Klaza herd beginning in 1985. Surveys were conducted roughly every one to three years between 1985–2003, annually from 2012–2016, and annually from 2023 to the present. During the 2000 composition survey, a total of 651 caribou were observed, which was used as a minimum count of the herd for many years, until the first mark-resight population estimate survey was completed in 2012.

Licensed harvest of the Klaza caribou herd has ranged from two to 13 caribou annually since 1995 (Figure 1). The herd has been managed under a Permit Hunt Authorization (PHA) system since 1991, with six resident permits for bull caribou available in Game Management Subzones (GMS) 5-22 through 5-26. In 2002 the number of permits increased to 12. Game Management Subzones 5-11 and 5-13 were added to the permit hunt area in 2003. Non-resident harvest (i.e., outfitters) is managed by a quota system administered separately from the resident allocation.

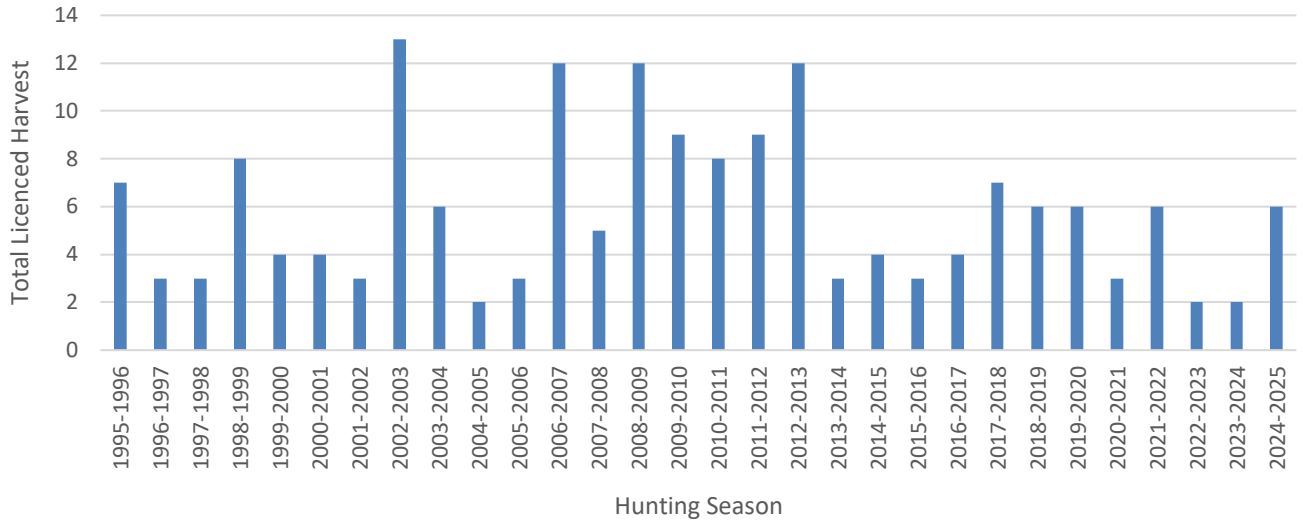


Figure 1. Total licenced harvest of the Klaza caribou herd, 1995 to 2024. These values do not include subsistence harvest.

Study area

The Klaza herd range is situated within the Yukon Plateau-Central ecoregion of the Boreal Cordillera ecozone, which is characterized by rounded and rolling hills, plateaus and broad valleys, interspersed with higher mountain ranges. Numerous lakes and smaller streams are found within the broad valleys in this ecoregion, including the Yukon River, which runs south to north from Lake Laberge to where the Pelly River intersects (Yukon Ecoregions Working Group, 2004). Elevations in the large river valleys are less than 500 m above sea level (asl), with the Tatchun Hills and various peaks in the Dawson Range between 1,750 and 1,850 m asl. The montane boreal forest is dominant in this ecoregion and contains a large variety of plant communities due to the high diversity of habitats. High frequency of fire favours lodgepole pine and trembling aspen at low elevations. Understory is predominantly lichen, kinnikinnick and grass.

The climate in this area is dry, with annual precipitation ranging from 250 to 300 mm. Mean annual temperatures are around -4°C, with mean winter temperatures ranging from -20°C to -30°C and mean summer temperatures ranging from 10°C to 15°C (Yukon Ecoregions Working Group, 2004). In addition to caribou, the area provides habitat for moose, snowshoe hare, lynx, grizzly bear, wolverine, marten and a variety of migratory birds (Yukon Ecoregions Working Group, 2004).

The Klaza caribou herd ranges northwest of Carmacks in the Dawson Range of west-central Yukon (Figure 2). The southern part of the range borders the Nisling River, including Mount Nansen and Victoria Creek. From the Nisling River, the range extends northeast towards Big Creek and Mount Pitts, and northward, encompassing Mount Cockfield and part of the Yukon River near Coffee Creek. The Klaza herd occasionally mixes with the neighbouring Aishihik herd to the south, and the herd's annual range also occurs within the historic range of the Fortymile caribou herd. The Fortymile caribou herd, which

once numbered in the hundreds of thousands, experienced a large decline to the low thousands by the 1970s due to extensive over-harvesting, then subsequently increased to ~84,000 by 2017 and decreased again to ~40,000 by 2022. Fortymile and Klaza caribou generally overlap during winter range expansions when Fortymile caribou move south into the Klaza range.

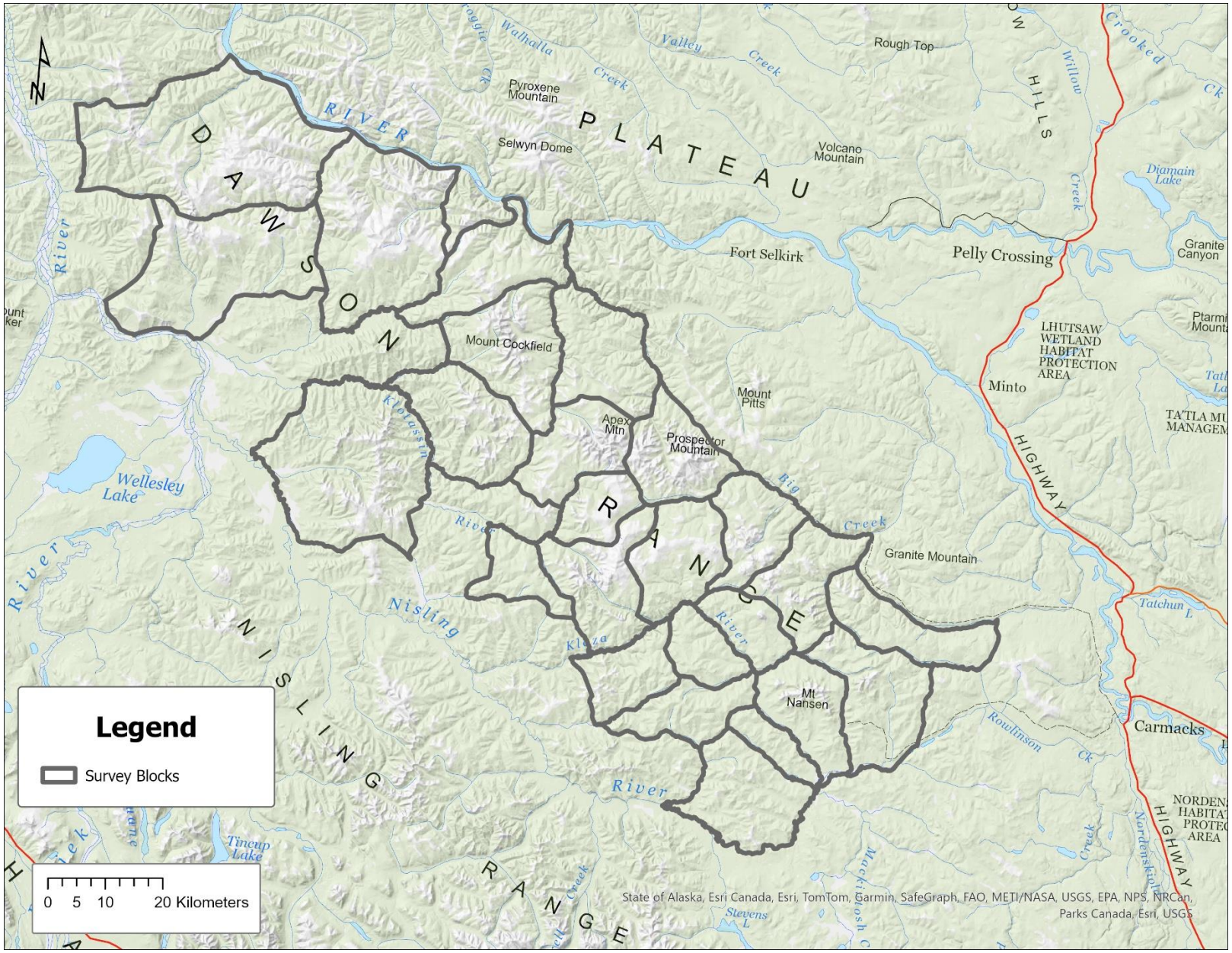


Figure 2. Klaza caribou herd 2024 mark-resight population survey blocks.

Methods

Collaring activities

Thirty-six caribou were captured via helicopter-based net-gunning (A-Star helicopter), with a three person capture crew in November 2023 and March 2024. All collars were fitted with unique colour-number combination visibility-bands to enable visual identification of individuals during aerial surveys, except for six solar-powered collars (Figure 3). Visibility bands could not be used on these collars because the collar band itself functions as a solar panel, and adding identification material would obstruct solar exposure and compromise collar performance.

Thirty of the captured caribou were affixed with Vectronic Aerospace Survey Iridium-2D collars programmed to record a GPS location every 3hrs 50min. The remaining six caribou were fitted with Vectronic Aerospace Solex collars, which feature a solar panel band that charges the battery. The Solex collars were programmed to take a GPS fix every 15 minutes under full power, and will send a GPS fix every hour, or go into sleep mode under low power. These location data are transmitted via the Iridium satellite to the Vectronic Inventa web service that provides locations daily to Government of Yukon biologists. These collars were also fitted with timed drop-off mechanisms that are scheduled to be released after 200 (Survey) or 400 (Solex) weeks from the time of deployment.

At the start of the population 2024 survey, there were 31 active caribou collars in the Klaza caribou herd. Two collared animals had already transmitted mortality signals prior to the survey, and three of the six Solex collars failed 1 to 2 months before the survey. The remaining active collars were generally well distributed across the study area, with the highest concentration of the collars located in the core of the Klaza range around Mount Langham and Mount Cockfield. A few animals were in the southern part of the range near Mount Nansen, and one individual was in the upper northwest portion of the range near Coffee Peak.

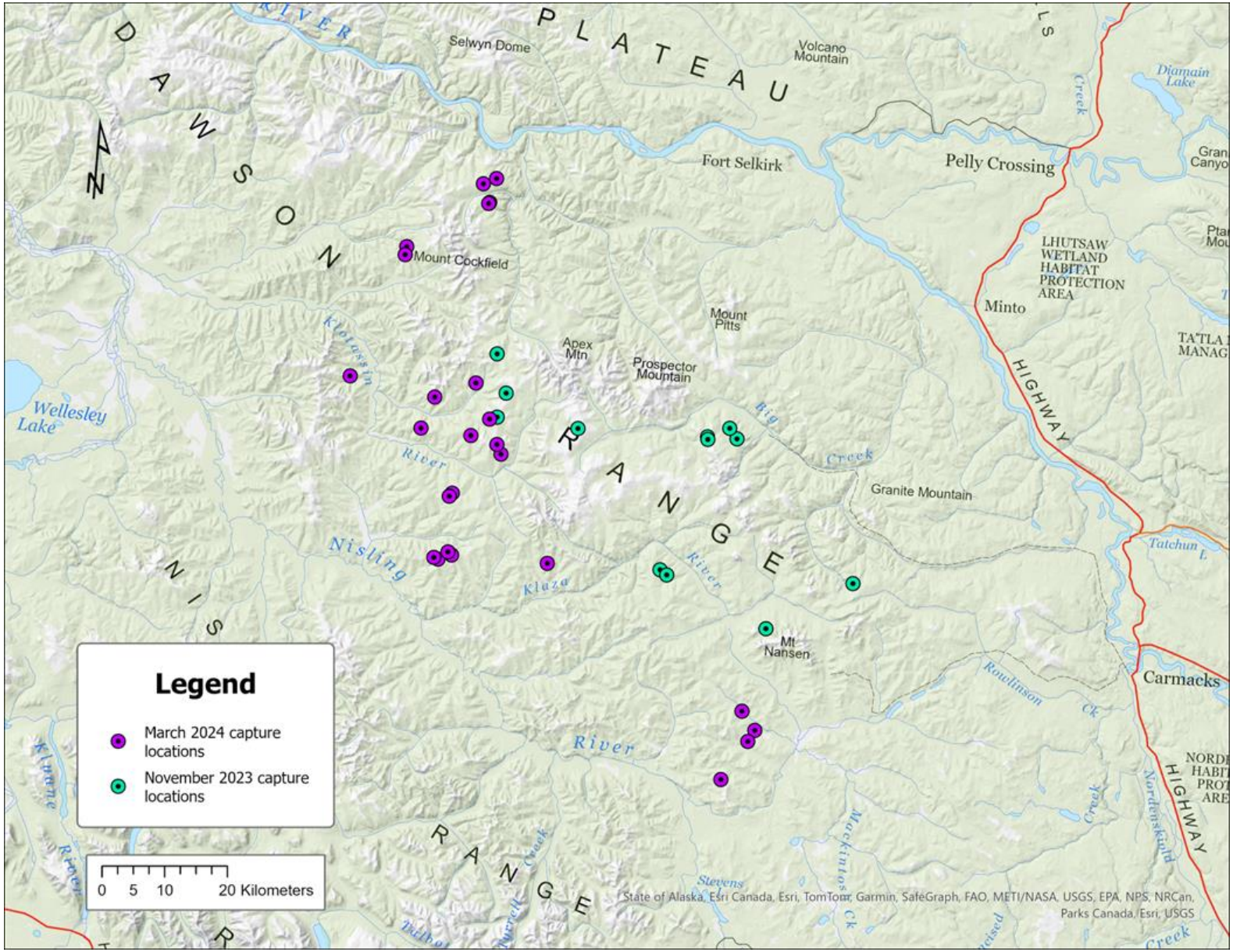


Figure 3. Klaza caribou herd capture and collar deployment locations, November 2023 to March 2024.

Survey methods

A mark-resight survey technique was used to estimate the number of caribou in the Klaza caribou herd. The mark-resight method uses collared caribou as 'marks', with the proportion of marked to unmarked caribou seen during the survey providing an estimate of the total population size. Three independent resighting sessions were conducted from 16 to 20 October 2024, with each session lasting three days. Surveys were flown using either a Eurocopter 120 or an A-Star FX1 helicopter, with unique observer crews assigned to each session. The study area was divided into 25 survey blocks, delineated based on fall rut locations from previous surveys, and collar locations (Figure 4). To ensure comparable survey effort across blocks, total flight time was allocated to each block based on its size and the number of caribou groups observed in that block during previous fall rut surveys. Each survey block was flown by all three crews over the course of the survey.

Within each survey block, crews concentrated their efforts on subalpine and alpine habitats, which were assumed to have a high probability of caribou occurrence during the fall rut. When a group of caribou was located, the total group size was recorded, and the number of marked and unmarked animals was recorded. A waypoint was recorded using a handheld GPS unit. Marked animals were identified by their unique vis-bands, when possible. When crews could not confirm a vis-band number (e.g., only one number was visible), telemetry was used to confirm the unique radio frequency of the collar. Telemetry was also used to confirm the identity of animals marked with Solex collars, as they do not have vis-bands. Telemetry was used exclusively for individual identification and was not used to locate collared individuals, as doing so would have violated the assumptions of the mark-resight methodology. During the third resighting session, animals were also classified as calves, cows, or immature and mature bulls to estimate herd composition. Composition counts were not conducted on the first two resighting sessions to minimize disturbance to animals and to reduce flight hours.

Data analysis

A population estimate for the Klaza herd was conducted using Program MARK (version 11.1). A mixed logit-normal modeling approach was used, as the herd range was considered geographically closed during the survey period and marks were uniquely identifiable. This model allows for individual heterogeneity in resighting probabilities by treating each animal as a random effect; however, if this parameter was not supported during model selection, the data was considered to have no individually identifiable marks and was fixed at zero (McClintock, 2018).

A set of four candidate models were evaluated using the survey data (Table 1). Models using all three or only two (e.g., Sessions 1 and 2, 1 and 3, or 2 and 3) of the resight sessions were evaluated. Model selection was based on Akaike's Information Criterion (Δ_i AIC_c; Akaike, 1973) adjusted for small sample sizes (AIC_c; Burnham & Anderson, 1998) and Akaike weights ($AIC_c w_i$) to select the model(s) with the

fewest predictor variables that explained the greatest variation in the data (i.e., the most parsimonious model). All models with a $\Delta i\ AIC_c$ of ≤2.00 were considered equally plausible (Richards, 2005, Symonds & Moussalli, 2011). To evaluate the effect of each individual mark-resight session on the overall estimate, each session was systematically withheld from candidate model runs to determine if confidence in the estimate was improved.

Table 1. Mark-resight candidate models fitted to the resighting survey data to estimate the abundance of the Klaza caribou herd.

Model	Description
$N\ p.\ \sigma=0$	Constant *p* across all resighting sessions, σ fixed at zero
$N\ p_t\ \sigma=0$	Different *p* for each resighting session, σ fixed at zero
$N\ p.\ \sigma.$	Constant *p* across all resighting sessions, σ as a random effect
$N\ p_t\ \sigma.$	Different *p* for each resighting session, σ as a random effect

Results

During the survey, the weather varied from high overcast clouds to a mix of sun and clouds, with good visibility. However, despite postponing the survey by two weeks due to a lack of snow, there was little to no snow on the ground in most survey blocks for all three resight sessions, which made spotting and tracking caribou particularly challenging. All 31 active collars were available in the survey blocks for the duration of the survey, except for one collared individual who was unavailable (moved out of the study area) during Sessions 2 and 3. Additionally, three of the deployed Solex collars were malfunctioning during the survey, thus their availability could not be confirmed. Availability was determined by examining GPS locations after the surveys were completed.

Crews were unaware of which marked animals were present in a block during their survey, and no telemetry equipment was used to locate animals, as this would have biased the resighting rates upwards (Figure 3). It was also apparent during the survey that the caribou were moving quite a bit throughout the survey area, as Sessions 2 and 3 both saw the same collared animal on different days in different blocks - indicating that rut groups were likely starting to break up. In these cases, the smaller of the two groups was omitted for the purpose of analysis, to avoid double counting animals. Although individuals moved among survey blocks during the survey period, movements occurred within the defined herd range and did not violate the assumption of demographic or geographic closure at the herd scale.

Population estimate

Resighting rates (i.e., recapture probability) were 0.52, 0.30, and 0.37 for Sessions 1, 2, and 3, respectively (Table 2) The selected model for the Klaza herd included a session-dependent resighting probability across sessions, and the parameter for individual heterogeneity fixed at zero (Table 2**,** Table 3). Including all three sessions in the analysis resulted in the most robust estimate. The top two candidate models had an $\Delta i\ AIC_c$ <2.00, making them equally plausible. To determine the final model, the one resulting in the smallest confidence intervals (CIs) was selected ($N\ p_t\ \sigma=0$). The final 2024 population estimate for the Klaza herd is **913 caribou (95% CI: 729–1,146)** (Table 4).

Table 2. Mark-resight survey results for the Klaza caribou herd, 15–20 October 2024.

Resight session	Survey effort (hours)	Total marked animals available	Total marked animals observed (unknown marks[a])	Total animals observed	Resighting rate
1 (15–17 Oct)	13.7	31	16 (1)	482	0.52
2 (16–18 Oct)	13.5	30	9 (1)	368	0.30
3 (18–20 Oct)	13.4	30	11 (1)	321	0.37

a: Unknown marks represent observations of malfunctioning Solex collars (no vis-bands). Unknown marks are not incorporated into the resighting rate.

Table 3. Candidate models for the 2024 Klaza caribou population estimate with model selection values.

Model	Rank	K[a]	AICc	Δi AICc	AICc weight
$N\ p.\ \sigma=0$	1	2	134.60	0.00	0.476
$N\ p_t\ \sigma=0$	**2**	**4**	**135.76**	**1.16**	**0.266**
$N\ p.\ \sigma.$	3	3	136.72	2.11	0.165
$N\ p_t\ \sigma.$	4	5	137.87	3.27	0.093

a: Number of model parameters including the intercept.

Table 4. Estimates of model parameters of the Klaza caribou herd from the selected mark-resight model.

Top model	Parameter	Value	SE	95% Confidence Interval
$N\ p_t\ \sigma=0$	**N**	**913**	**106**	**729–1,146**
	p_1	0.520	0.090	0.348–0.687
	p_2	0.301	0.084	0.164–0.486
	p_3	0.369	0.089	0.217–0.552

The selected model included a time-dependent parameter for resighting probability, suggesting there may have been differences in detection rates among resight sessions. These differences could be attributed to varying survey conditions and resight rates across sessions, with Sessions 2 and 3 exhibiting a slightly lower resight rate compared to Session 1 (Table 2). Individual heterogeneity was not included in the model as a random effect, indicating that there were no significant differences among marked individuals that made them more difficult to detect. Further examination of the individual encounter histories (i.e., which marked animals were observed across resight sessions) revealed that 23% of available marked animals were not detected during any resighting session, supporting the decision to fix the individual heterogeneity parameter to zero. As missed detections were not consistently associated with specific individuals, it was more likely attributable to session-level detection processes.

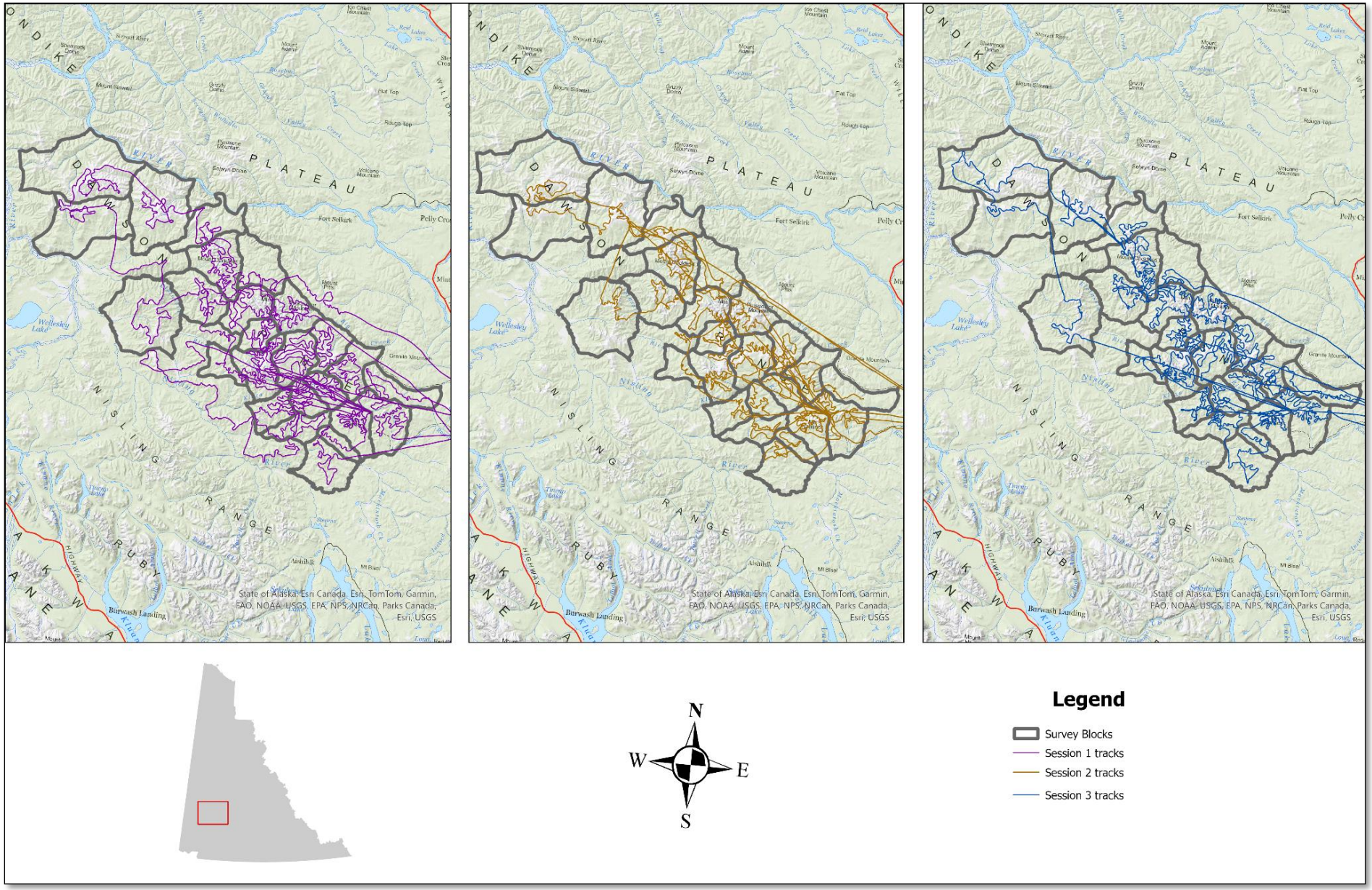


Figure 4. Flight lines from all three sessions of the 2024 mark-resight population survey of the Klaza caribou herd.

Herd composition

During the third resighting session, observed caribou were classified by sex and age to determine the herd composition. A total of 321 caribou were observed during this session, and all individuals were classified as cows, calves, mature or immature bulls (Table 5). The observed ratios were applied to the 2024 population estimate to estimate total herd composition (Table 6).

The fall calf recruitment ratio for 2024 was estimated at 31 calves per 100 cows which is above the minimum fall recruitment ratio needed for a stable population growth rate (20 to 25 calves per 100 cows) as outlined in the *Science-based guidelines for management of Northern Mountain caribou in Yukon* (Environment Yukon, 2016). The 2024 recruitment estimate represents an improvement from the previous two surveys, which recorded 25 and 19 calves per 100 cows in 2023 and 2016, respectively.

The adult sex ratio in 2024 was estimated to be 38 bulls per 100 cows, which is above the recommended threshold of 30 bulls per 100 cows to ensure reproduction and maximized genetic diversity (Environment Yukon, 2016). This is consistent with recent surveys that also exceeded the management target (45 and 33 bulls per 100 cows in 2023 and 2016, respectively).

Fall composition surveys have been conducted on the Klaza herd intermittently since 1987 (Figure 5, Figure 6). Recent surveys (2023 through 2025) indicate calf recruitment is above the recommended threshold of 20 to 25 calves per 100 cows with a 3-year average of 33 calves per 100 cows. Over the same period, bull to cow ratios have also exceeded the management target of 30 bulls per 100 cows with a 3-year average of 47 bulls per 100 cows, indicating a currently healthy herd structure. It is important to analyze long-term trends in calf recruitment and adult sex ratios to gain a more comprehensive understanding of the herd's overall trajectory, as annual estimates may fluctuate. For this reason, additional composition data collected over the next two years will be critical to confidently assess long-term trends in herd status. Composition surveys for this herd are planned annually until fall 2027 and every other year thereafter.

Table 5. Observed composition of the Klaza caribou herd, October 2024.

Survey	Calves per 100 cows	Percent calves	Bulls per 100 cows	Number of caribou classified	Number of caribou unclassified
October 2024, resight #3	31	18	38	321	0

Table 6. Estimated composition of the Klaza caribou herd based on estimated age and sex ratios and population estimates, October 2024.

Estimated herd size	Calves	Cows	Bulls
913	168	540	205

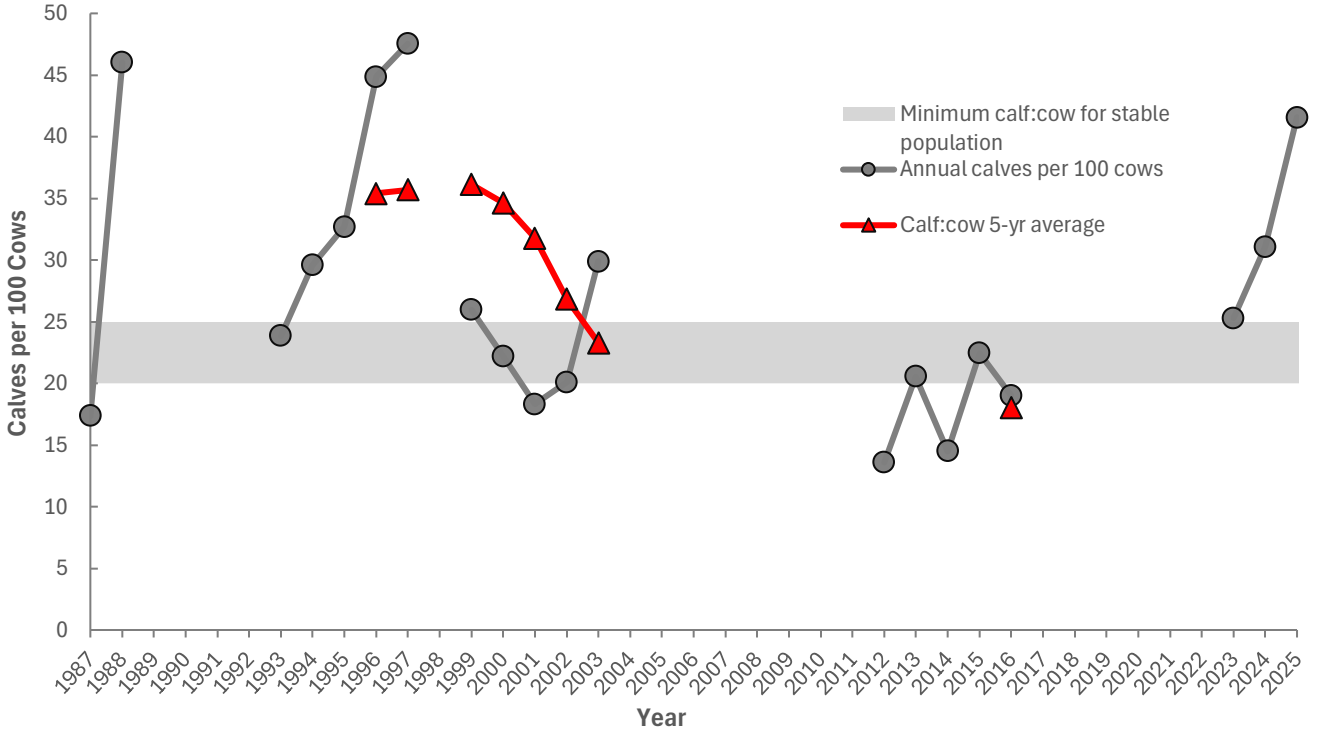


Figure 5. Measure of recruitment of calves per 100 adult cows, calculated from composition surveys conducted during fall on the Klaza caribou herd, 1987-2025. Five-year average values are calculated only when there are five or more years of data that are two years or less apart.

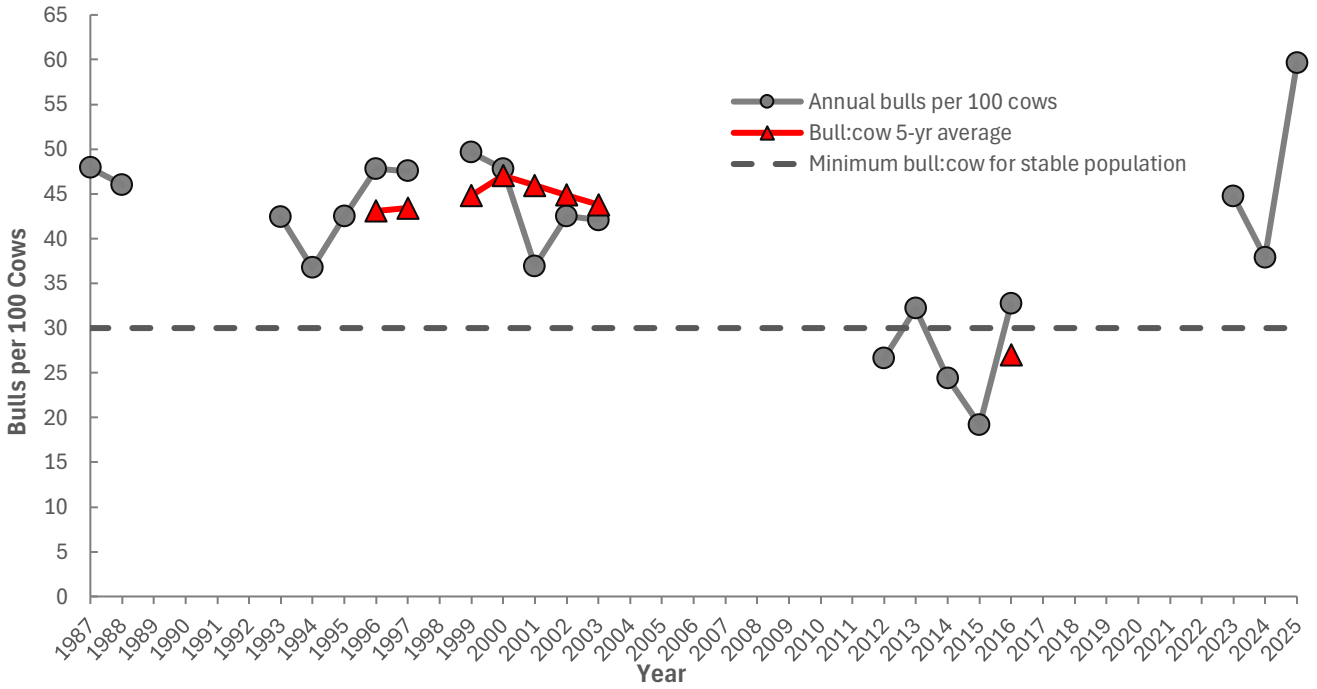


Figure 6. Measure of adult sex ratio as number of bulls per 100 adult cows, calculated from composition surveys conducted during fall on the Klaza herd, 1987-2025. Five-year average values are calculated only when there are five or more years of data that are two years or less apart.

Distribution

Caribou groups were primarily distributed on open alpine and subalpine rutting areas throughout the Klaza herd range, northwest of Carmacks (Figure 4). Observed groups ranged in size from 1–65 individuals, with an average of 11 individuals per group. Caribou were distributed throughout the study area, with the highest concentrations observed in the core of the range in the vicinity of Mount Langham, south of Apex Mountain and just south of the Klaza River. A smaller number of groups were also observed just south of Mount Cockfield. The largest group (65 animals) was observed in a lower-lying area south of Maloney creek and north of the Nisling River, which is considered the southern boundary of the herd range. The second largest group (44 animals) was also observed in a lower-lying area near Bow Creek, north of Victoria Mountain. Smaller groups of caribou were scattered across the study area, typically in open, rolling hills; however, all within the core of the herd range.

During the survey, it was apparent that the caribou were starting to move out of rutting areas, as some marked animals were observed on multiple days in different survey blocks, and tracks and animal movements suggested increased travel across the landscape. This assertion was confirmed by post-survey examining the GPS collar data, which showed some individuals moved long distances across multiple survey blocks throughout the duration of the survey period.

Interpretation of population estimate results

To better understand the 2024 Klaza caribou herd population estimate and the herd's current trend, results are compared to the previous 2012 population estimate and with other demographic data collected over time. This comparison is supplemented with regional context relating to habitat, weather patterns, and neighbouring caribou herds.

The previous population estimate of the Klaza herd from 2012 was 1,179 caribou (95% CI: 952–1,461) (Hegel, 2013). Though the 95% CI of the 2024 Klaza caribou population estimate overlaps with the 95% CIs of the 2012 estimate (Table 7**,** Figure 7), the estimate itself falls below the previous one (Hegel, 2013). Given that the 2012 and 2024 surveys employed consistent mark-resight methodologies, they are considered directly comparable. We evaluate both the 90% and 95% CIs to provide a more complete picture of the uncertainty around the latest population estimate and highlight the trade-off between confidence and precision.

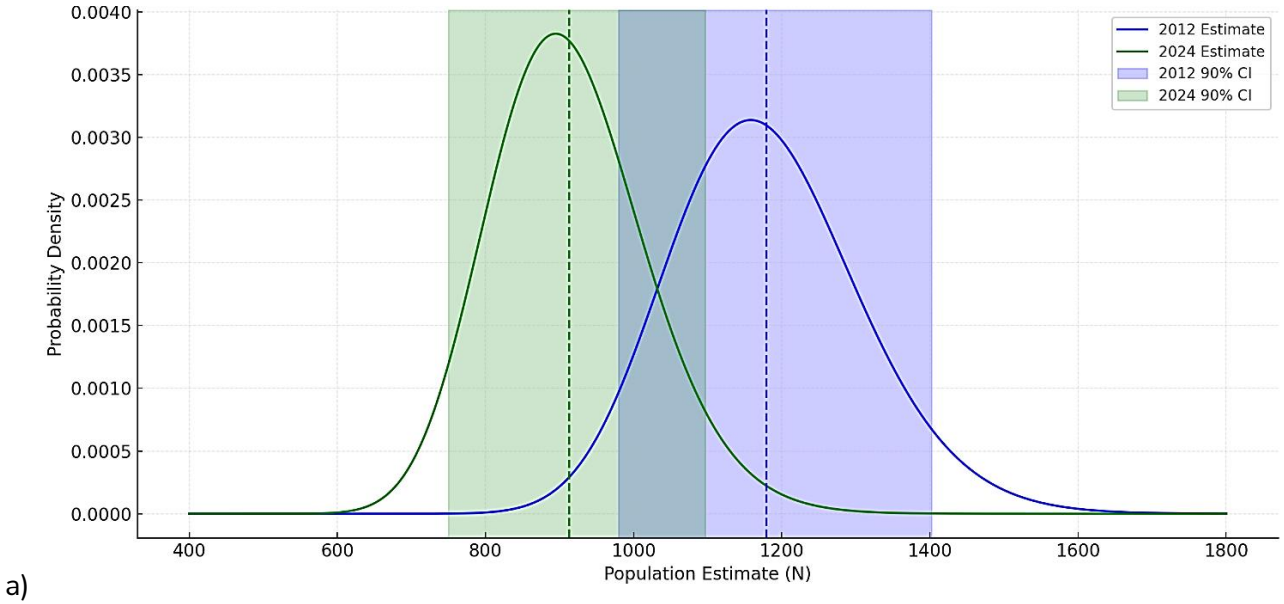
Table 7. Klaza caribou herd population estimates from 2012 and 2024, with both the 90% and 95% confidence intervals (CI).

Year	Estimated Herd Size	90% CI	95% CI
2012	1,179	985–1,411	952–1,461
2024	913	754–1,105	729–1,146

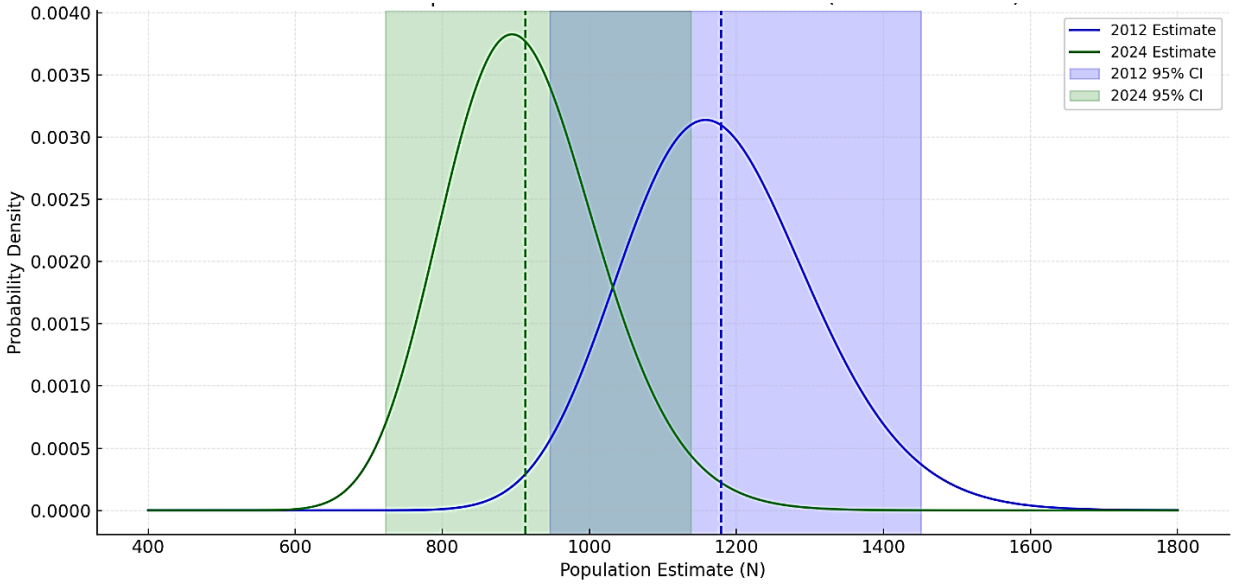
Confidence comparisons — what's the difference between 90% and 95% confidence intervals?

In the context of estimating a caribou herd's population size, a confidence interval is a range of values derived from survey observation data, that is used to estimate an unknown population parameter, such as the population's size. Instead of presenting a single point estimate of herd size, a confidence interval provides a range of plausible values where the true value is likely to fall. This accounts for variability and helps communicate the uncertainty that naturally arises when we are estimating based on a sample rather than an entire population (i.e., we know we are not seeing every caribou in the population when conducting a survey, thus what we observe is a sample).

Comparing 90% and 95% CIs directly illustrates the precision of the population estimate. If the 90% CI is very narrow but the 95% CI is wide, it signals that the precision is sensitive to the level of confidence. A 95% CI is wider and more certain, while the 90% CI is narrower and more precise. A 95% CI is more statistically cautious, while a 90% CI relaxes that caution, resulting in a higher risk (10% versus 5%) that a detected change might be due to random chance. Although the 90% CI represents a higher risk that the change detected might be due to random chance, it can help to detect trends earlier and be more sensitive to potential changes, which may be important for management or conservation decisions. Presenting both allows us to evaluate the population estimate's reliability based on our level of risk tolerance.



a)



b)

Figure 7. Comparing the Klaza caribou herd estimates from 2012 and 2024 using both 90% (a) and 95% (b) confidence intervals.

To explore the probability of a difference between the 2012 and 2024 estimates (i.e., one-sided and two-sided probabilities), a log-normal approximation (i.e., log transformation to stabilize variance) was used since the population estimates are not normally distributed (Figure 7). The probability that there was a decline in the herd's size from 2012 to 2024 is 94.6%, while the probability that the two estimates differ is 10.9%. Using 90% CIs, the overlap between the 2012 and 2024 population estimates is narrower (Figure 7), increasing confidence that a decline occurred over the 12-year period, though it still does not meet strict statistical significance. The detection probabilities from the 2012 and 2024 surveys are similar (Table 2; Hegel, 2013), with overlapping CIs, suggesting that the apparent population change is unlikely due to changes in detectability between surveys.

While there is strong evidence of herd decline occurring between 2012 and 2024, it is important to consider the magnitude and rate of change. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) uses quantitative benchmarks for population decline to determine the at-risk status of a species. For example, if a population experiences >30% decline over three generations, it would be considered Threatened. Between 2012 and 2024, the Klaza caribou herd declined by 22.6%, corresponding to an average annual rate of decline of 2.1% per year. Three generations for caribou is estimated to be ~27 years, thus a constant 2.1% annual decline would equate to a ~43% decline over three generations, exceeding the COSEWIC benchmark. However, this extrapolation should be interpreted cautiously, as population trajectories are unlikely to follow a constant rate of change over time.

By examining the herd's composition data over time, we can see that from 2012 to 2016, the herd likely experienced conditions consistent with decline, as evidenced by an average calf recruitment value of 18 calves per 100 cows, which is below the threshold (20 to 25 calves per 100 cows) indicative of a stable population (Figure 5). Additionally, the average adult sex ratio over this period was at 27 bulls per 100 cows, which is also below the stable threshold of 30 bulls per 100 cows (Figure 6). Monitoring was limited from 2017 through 2022; thus the timing and rate of the observed decline cannot be resolved, and the decline may have occurred over a shorter or longer interval than implied by the two estimates. From 2023 to 2025, both the herd's calf recruitment and adult sex ratios averaged well above stability thresholds, suggesting the herd's current trend is either stable or increasing and is likely not experiencing a sustained decline.

Framing the 2024 population estimate within the context of regional habitat change and weather patterns provides additional insight into potential drivers of past population change. The Klaza herd's annual range has experienced an increase in surface disturbance since 1985, with peaks of disturbance occurring in 1990, 1996, and 2019 through 2021, which largely aligns with community knowledge holder-reported peaks in development from 1995 to 1999 and 2015 to 2019 (Elliott, 2025). While quantification of surface disturbance captures direct footprint, it does not account for sensory disturbance that creates a zone of influence (ZOI) around infrastructure and industrial activity, that may

result in avoidance of otherwise suitable habitat by caribou. The Klaza herd range also experienced wildfire-related habitat loss. In 2010, the area impacted by recent wildfires (≤50 years old) covered 603 km^2. This area increased to 742 km^2 in 2015. As older fires regenerated, the area impacted dropped in 2020 to 646 km^2 (Elliott, 2025). Although caribou have evolved with natural disturbance regimes such as wildfire and can persist in burned landscapes, evidence suggests that cumulative industrial activities and anthropogenic disturbance have greater influence on caribou recruitment and population dynamics than wildfires alone (Stewart, Nowak, Micheletti, McIntire, & Cumming, 2020).

Direct loss of habitat reduces a caribou's ability to forage sufficient resources for survival and reproduction and is often compounded by behavioural avoidance of disturbed or active industrial areas (i.e., functional loss). Functional loss, whereby otherwise suitable habitat is avoided due to sensory or physical disturbance, often exceeds direct loss of habitat. There is a strong negative relationship between human disturbance and female caribou survival and calf recruitment, demonstrating that disturbance affects not only caribou behaviour, but population demography as well (Fortin, et al., 2017; Johnson, et al., 2020; Palm, 2021). Continued increases in both surface and sensory disturbance within the Klaza herd range may therefore have displaced caribou from higher quality habitats into sub-optimal habitat areas, potentially contributing to reduced survival and recruitment over time.

Caribou are particularly vulnerable during winter, when resources are limited and energetic needs are high. Deep or hard-packed late winter snow conditions can compound during this time, further leading to reduced feeding efficiency and lower overall energy intake. Late winter also coincides with the last three months of pregnancy for cow caribou, during which time energetic requirements increase substantially. During this period, disturbance, stress, or avoidance of high-quality habitat can exacerbate declines in body condition and negatively affect reproductive success. Broad regional snowpack data from Government of Yukon's Water Resources Branch demonstrates that from 2021 to 2023, areas in the Central (Carmacks) water basin had considerably higher than normal values for late season (May) snow water equivalency (amount of water released from snowpack when it melts; Yukon Snow Survey Bulletin and Water Supply Forecast data 2012–2024; Figure 8). The observed snowpack patterns may have influenced caribou energetics and survival during this period and could have contributed to increased vulnerability and mortality. However, it is not possible to attribute the observed demographic changes or mortality rates to snow conditions alone.

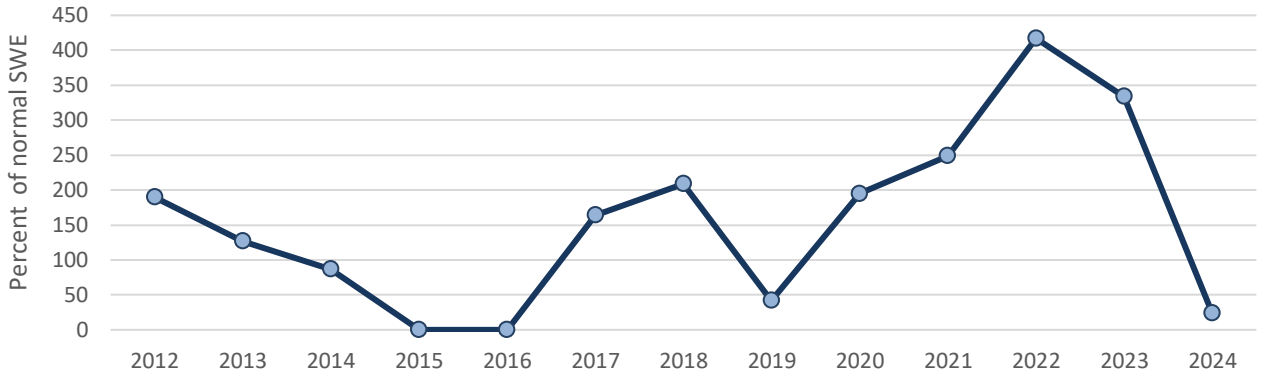


Figure 8. Percent of normal May snow water equivalency patterns in the Central (Carmacks) water basin from 2012 to 2024 (Yukon Snow Survey Bulletin and Water Supply Forecast 2012-2024).

Management implications

The 2024 mark-resight survey results indicate that the Klaza herd experienced a decline over the past decade. While not statistically definitive, these findings strengthen evidence of a change in herd status from 2012 to 2024. At the same time, early results from the current monitoring program (2023 to present) suggest calf recruitment may currently be enough to offset adult mortality and sustain the population. Despite these recent encouraging demographic indicators, the combination of estimate uncertainty, ongoing and increasing pressures to the herd's range, and limited understanding of the mechanisms driving the earlier decline, supports a precautionary management approach.

From a management perspective, the lower estimated population size in 2024 compared to 2012 warrants particular attention for several reasons. First, because of altered predator-prey dynamics, increased energy expenditure, and behavioural changes, declining caribou populations are more sensitive to disturbance. The magnitude of decline between the two population estimates (-22.6%) demonstrates how quickly the herd's trajectory can change. Although the herd may not currently be declining, our understanding of the mechanisms of this decline is limited. Additionally, future risks to this herd persist due to ongoing cumulative impacts to the herd's annual range – primarily persistent placer and quartz mineral interest and exploration, and the Casino Mine Project, which is now beginning a YESAB Panel Review process.

The results of this survey fulfill part of the monitoring requirements set out by the YESAB for the Coffee Gold Project and associated Charlotte Property. These requirements emphasize the need for updated and accurate population data to inform adaptive management in the face of industrial development and cumulative effects. Integrating herd size and demographic data with information on habitat use, seasonal movement, and interactions with surface disturbance will improve the ability to forecast potential impacts and evaluate the effectiveness of mitigation measures.

Collaborative planning with overlapping First Nation governments will ensure that management decisions respect Indigenous rights, knowledge systems, and stewardship values. Joint interpretation of incoming monitoring results will strengthen management actions, whether they involve adjusting harvest rates or implementing protective measures for key habitats. Regarding harvest management, the number of Permit Hunt Authorizations and outfitter quotas for this herd should be re-evaluated to ensure they are consistent with the herd's current population size, demographic indicators and trend information as additional data becomes available. Such adjustments, if required, will be made in collaboration with overlapping First Nations and outfitting concession holders.

While the Klaza caribou herd may not currently be declining, its smaller size compared to a decade ago, coupled with the need for additional calf recruitment estimates over the long-term to increase confidence in the population status, highlights the need for ongoing monitoring and careful

management. The completion of the five-year program will provide evidence to guide long-term strategies that balance ecological sustainability, cultural values, and harvest opportunities. Additional work on the herd's demographics, such as mortality rates and sources, as well as another population estimate within the next 10 years, will help evaluate long-term trends and support informed management decisions.

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