Yukon

SR-24-11

Caribou population and distribution studies in the Tay River region

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Government of Yukon
Fish and Wildlife Branch
SR-24-11

Authors

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Acknowledgements

Many people over the years have contributed their time and knowledge to gūdzı̨h/hudzì/caribou in this region. Thank you to the Ross River Dena Council (RRDC) for their support during this population survey. Thanks to Robbie Dick, Gordon Peter, Henry Nukon, Yasmin Djabri and Eric Palm for their assistance as aerial observers. Many thanks to our pilots Ammon Hoefs with Horizon Helicopters and Bill Karman from Kluane Helicopters for their excellent flying during the population survey. Government of Yukon staff who participated in the population survey included Alex Francis, Joe Bellmore, Traci Morgan, Jaylene Goorts and Troy Hegel.

Two capture programs, in 2016 and 2020 also informed this work. Gerd Mansperger from Alpine Aviation flew the 2016 fixed-wing reconnaissance flight with aptitude. In 2016 the capture crew included YG staff Martin Kienzler, Kyle Russell, Troy Hegel, Traci Morgan and Alain Fontaine, and was made possible by the excellent flying of Doug Hladun from Trans North Helicopters and Dion Parker from TRK. In 2020 the capture crew included Government of Yukon staff Martin Kienzler, Mike Suitor, Meghan Larivee and Laurelie Menelon, with superb piloting from Vince Edmonds of Horizon Helicopters.

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Suggested citation:

RUSSELL, K.L., K. BECKMANN, J.POTIÉ, K.J. RUSSELL, AND M. O'DONOGHUE. 2024. Caribou population and distribution studies in the Tay River region (SR-24-11). Government of Yukon, Whitehorse, Yukon, Canada.

Executive Summary

From 1989 to 1992, inventory studies of the Tay River and Moose Lake caribou herds were conducted to better understand herd size, composition, seasonal movements and distribution, and habitat use to inform decisions related to harvest and land use. In 2016, a project was initiated for the Tay River herd due to concerns that information on herd status and distribution was outdated. New information on the status and distribution of the herd was required to both inform environmental assessment processes and to ensure that harvest was occurring within recommended guidelines. We deployed satellite GPS collars on caribou in the Tay River and Moose Lake regions in 2016 and 2017, and conducted population estimate surveys on both herds in September and October 2017 to update their status.

- The 2017 population estimate for the Tay River herd is **1,880 (95% CI: 1,735–2,112)** animals. In 1991, the Tay River herd was estimated at 3,758 (95% CI: 3,080–4,436) animals. The 2017 results represent a considerable difference between the two estimates, which we explore using all available data from 1982 to 2024.

- The 2017 population estimate for the Moose Lake herd is **173 animals (95% CI: 158–191)**, which is the first official population estimate for this herd. In 1991, biologists estimated the Moose Lake herd was made up of around 300 animals. This estimate was based on a minimum count of 211 animals observed during a fall composition survey and subsequent sightability correction. Distribution information indicates there is another, similarly sedentary group of animals north of the Hess River, numbering less than 200 animals. The Moose Lake herd range boundary was expanded to include these animals, resulting in a combined total population estimate of around **400 animals**.

A desktop assessment of location data up to 2024 was also conducted to further investigate the notable difference in population estimates between 1991 and 2017. This assessment took a closer look at the survey areas and methods, collar movement data and documented habitat changes in the area, and concluded that there are likely several factors that may have led to the lower population estimate in 2017. These may include natural mixing and possible immigration and emigration of Tay River and Redstone animals, changes in movement patterns due to wildfire, and/or a potential slow population decline for unknown reasons. However, recent calf recruitment data (2016–2019) are indicative of a stable herd.

Two changes to the Tay River herd range boundaries are described – first, a smoothing of the northeastern range boundary to better delineate between the Tay River and Redstone herds, and second, the Moose Lake herd range was combined with that of a distinct sub-group of animals north of

the Hess River, previously designated as Tay animals, who have been observed to make smaller localized movements in that area.

We recommend continued monitoring work be conducted in the Tay River area given the uncertainty surrounding the 2017 population estimate and our improved understanding of distribution. We recommend monitoring priorities, approaches, and timing be discussed and planned by working with partners from the First Nation of Na-Cho Nyäk Dun, Selkirk First Nation and the Kaska Dena.

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Introduction

The Tay River and Moose Lake caribou herds are part of the Northern Mountain (NM) population of woodland caribou (*Rangifer tarandus caribou*), which are currently listed as Special Concern under the federal *Species at Risk Act* (Environment Canada, 2012). Located north of Ross River and southeast of Mayo, the Tay River and Moose Lake herds were historically considered a single group, but results from seasonal radio-collar relocation studies that began in the 1980s found animals in the Moose Lake group "*…make a distinct pattern of short movements from a wintering area near Moose Lake to a summer range in the neighboring mountains to the east*" (Kuzyk & Farnell, 1997). Neighbouring herds include the large Redstone herd to the north and east, which interacts with the Tay River herd during calving to rut and winters in river valleys along the Yukon-NWT border, the Finlayson herd to the southeast, the Pelly herds to the southwest, the Tatchun herd in the Glenlyon Range to the west, and the small Ethel Lake herd to the northwest of the Moose Lake herd.

From 1989 to 1992, inventory studies of the Tay River and Moose Lake herds were conducted to better understand herd size, composition, seasonal movements and distribution, and habitat use to inform decisions related to harvest and land use (Kuzyk & Farnell, 1997). This work culminated in a population estimate for each herd in 1991: the Tay River caribou herd was estimated at 3,758 (95% CI: 3,080–4,436) animals using a winter stratified random block survey, while a formal population survey for the Moose Lake herd was not conducted, but 211 caribou were observed during the 1991 rut count survey and biologists estimated the herd may number up to 300 animals (Kuzyk & Farnell, 1997). It was concluded that based on population and composition estimates, both herds were stable and average harvest was considered sustainable at 3%, with a note that the small size of the Moose Lake herd make it particularly vulnerable to human development and harvest pressure.

Between 1991 and 2016, minimal monitoring was carried out on the Tay River and Moose Lake herds, with a fall composition survey conducted in 2003 and a late winter distribution survey in 2009. Incidental caribou locations were also collected during a 2011 early winter moose survey based in Faro. In 2016, a project was initiated for the Tay River herd due to concerns that information on herd status and distribution was outdated. New information on the status and distribution of the herd was required to both inform environmental assessment processes and to ensure that harvest was occurring within recommended guidelines. In response, satellite GPS collars were deployed on both herds to update information on distribution and movement, provide marks for a mark-resight population survey, and support multiple fall composition surveys to update demographic trends.

This report details the results of the 2017 mark-resight population survey, along with a desktop assessment of collar and survey data from 1982–2024. This assessment helps to further our understanding of changes in caribou movements and range use in the area between the 1991 and 2017

population estimates. Rut composition surveys were conducted on the Tay River herd in 2003, and annually from 2016 to 2019. The late winter survey conducted in 2009 in Tay River winter range identified considerable areas affected by recent wildfire that may have altered distribution and movement patterns. Wildlife Key Area (WKA) surveys of caribou in the upper Stewart River watershed were conducted annually using helicopters in late September and early October from 2018 to 2022. The main purposes of the WKA surveys were to map the distribution and rutting habitats of caribou in this area, and to evaluate abundance of caribou in the northern part of the previously mapped Tay River caribou herd range, an area experiencing increasing levels of mineral exploration.

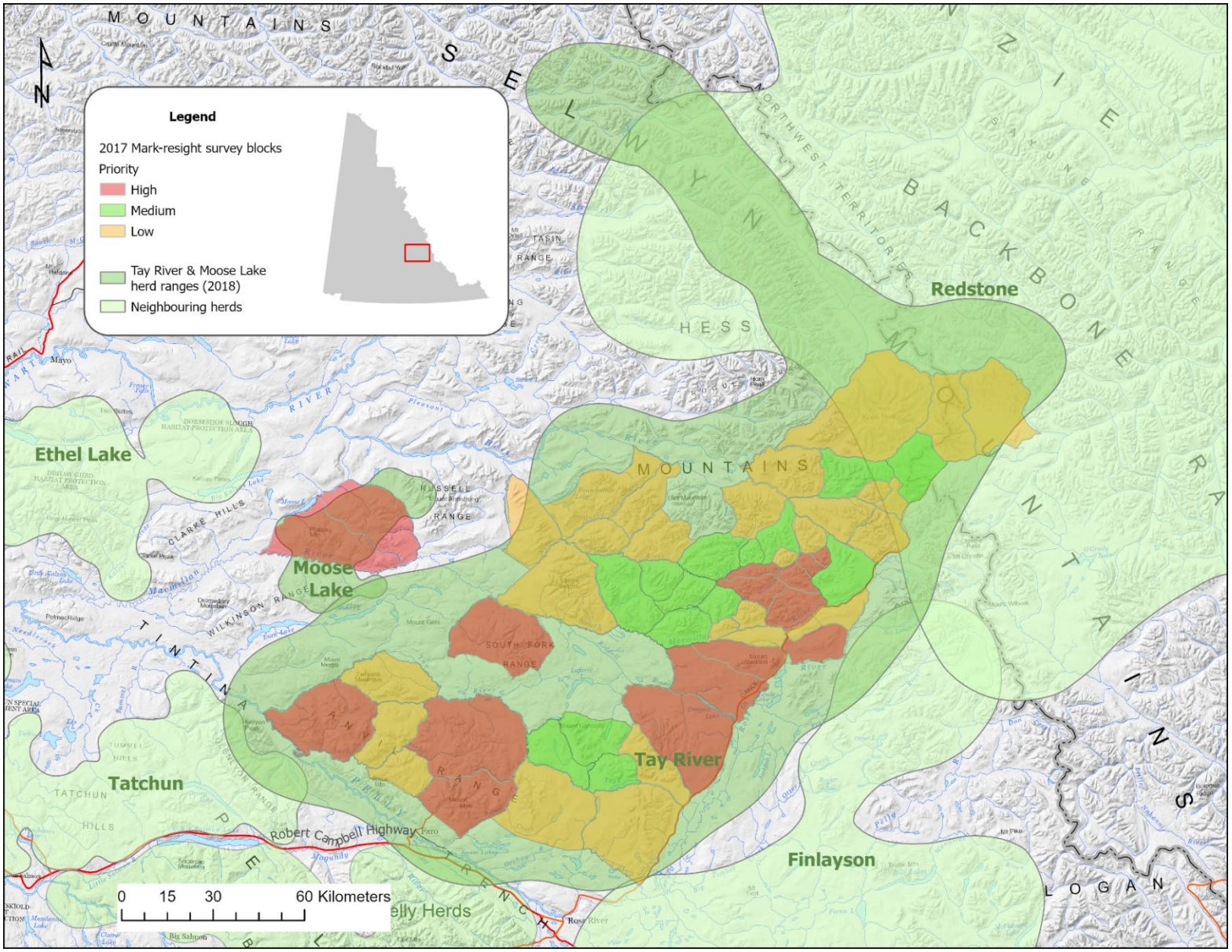
Together, these technical data have helped to form a relatively comprehensive understanding of caribou in the region, including how and when Tay River caribou interact with other herds, distinctive movement ecology displayed by different herds, and how population sizes have changed over time.

Study Area

The Tay River herd range extends northeast towards the NWT border, overlapping with the Redstone herd in the Mackenzie Mountains to the east, the Finlayson herd to the southeast, and the Tatchun and Pelly herds to the southwest (**Map 1**). The Moose Lake herd range is relatively small as these groups tend to make more limited, localized movements concentrated around either Moose Lake or north of the Hess River. These herds fall within the Traditional Territory of the First Nation of Na-Cho Nyäk Dun and Selkirk First Nation, and the traditional territory of the Kaska Dena. Both herds are located in the Yukon Plateau-North Ecoregion, which is characterized by mountainous terrain with numerous lakes and large river drainages flowing in a westerly direction (Yukon Ecoregions Working Group, 2004). Elevation ranges from 600 m in the valleys to over 1,500 m in the hills and mountains. The climate has characteristically long, cold winters and short, hot summers. The mean annual temperature is near -5ºC but with strong seasonable variability. Precipitation ranges from 300 mm in lower elevations to 600 mm in higher elevations. Black (*Picea mariana*) and white spruce (*P. glauca*) are the dominant tree species. Lodgepole pine (*Pinus contorta*) and trembling aspen (*Populus tremuloides*) grow on the drier and recently burned sites while sub-alpine fir (*Abies lasiocarpa*) occurs intermittently at treeline (Yukon Ecoregions Working Group, 2004).

The herd ranges are located generally north and east of Faro and Ross River, and southeast of Mayo, Yukon. Access to these areas is limited, with the North Canol Road serving as the major route, along with secondary trails, rivers and lakes. The study area is bordered by the Robert Campbell Highway in the south and the Glenlyon Range to the west. The eastern boundary of the study area is the North Canol Road, which is accessible to wheeled vehicles in summer and snowmobiles in winter. There is limited access for off-road vehicles from the major highways; however, some trails (e.g., Plata Winter Trail) and mining exploration roads off the west side of the North Canol Road do provide access into the Tay River herd range. The Macmillan, Pelly and Stewart Rivers provide access and drain the area in a westerly direction.

The survey area for the 2017 population estimate focused on known rutting areas within the Tay River and Moose Lake herd ranges. For the Tay River herd, these are primarily located west of the North Canol Road and north of the South Macmillan River, with some smaller rutting areas distributed throughout other portions of the range (**Map 1**). For the Moose Lake herd, survey blocks were located on the mountains immediately south of Moose Lake, including Plateau Mountain and the high elevation areas around Limestone and Marion Creeks (**Map 1**). These areas were identified through historical monitoring and inventory work completed in the 1980s and 90s and confirmed by a more recent fall composition survey (2016), GPS collar locations (from March 2016 onwards), and local knowledge. The total Tay River survey area was 16,689 km^2, divided into 55 survey blocks. Two survey blocks were delineated in the Moose Lake herd range, ranging in size from 28 km^2 to 1,043 km^2 and followed natural terrain features as much as possible (**Map 1**). Survey blocks were also designed to cover the distribution of the GPS collared caribou (marks) to ensure they were available for detection during the survey.



Map 1. Study area for the 2017 Tay River and Moose Lake mark-resight population survey showing prioritized survey blocks.

Methods

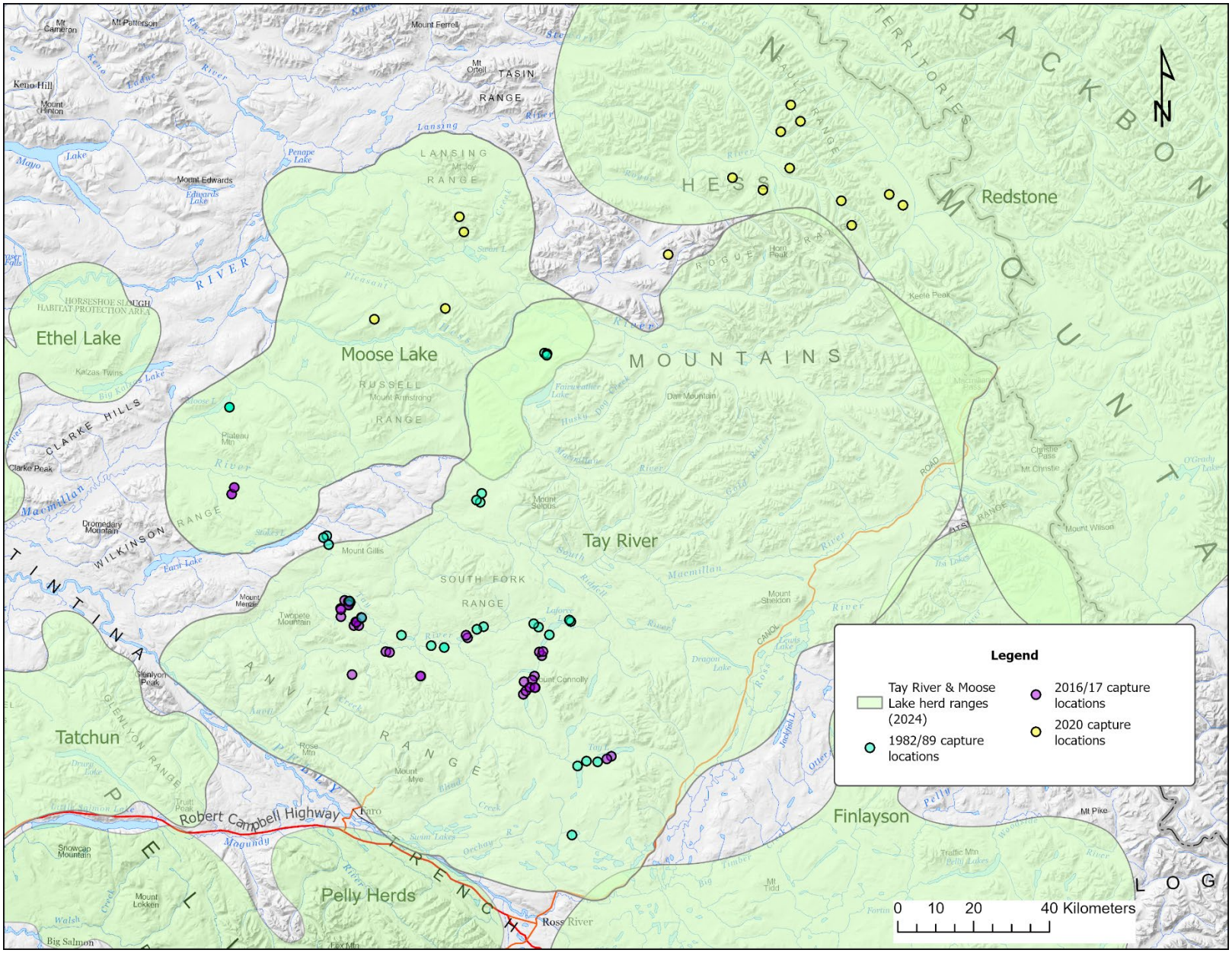
The methods below describe the approaches used to assess distribution, composition, and population size in the Tay River area. To estimate population size, we use a mark-resight survey technique to estimate the number of caribou in the Tay River and Moose Lake caribou herds. The mark-resight method uses collared caribou as 'marks', and the proportion of marked to unmarked caribou seen during the survey to estimate the total population size. To better understand and characterize distribution and movement over time, a desktop assessment of all available location data from aerial surveys and collared animals (1982–2024) was also conducted.

Collar deployment (1982–2020)

Prior to 2016, collar programs on the Tay River and Moose Lake herds occurred in 1982 and 1989. In 1982, three female Tay River caribou were collared, and in late winter of 1989, 23 female Tay River animals and four Moose Lake animals were fitted with VHF radio-collars. The captures were done using a net-gun and helicopter, with animals primarily collared in the Tay River, Tay Lake, and LaForce Lake area (**Map 2**). Seasonal relocation flights were then conducted to track collared caribou.

In March 2016 and February 2017, 37 GPS collars were deployed on the Tay River herd, and two on the Moose Lake herd. Caribou were captured using an A-Star helicopter, net-gun, and a three person capture crew. Captured caribou were affixed with either Lotek Iridium Track M 2D or Lifecycle collars that were programmed to drop off after three years of service. Location fix rates were set to one location every 23 hours. The collars were also fitted with uniquely coloured and numbered visibility bands to serve as "marks" during the population estimate survey. Collars deployed on the Tay River herd were distributed in the southern part of the herd's range, south of the South Macmillan River and between Twopete Mountain and Tay Lake (**Map 2**). A fixed-wing reconnaissance flight crew searched for animals in the northern part of the range but did not find any, thus all collars were deployed south of the Hess River.

In October 2020, an additional 15 GPS collars were deployed north of the Hess River, from Pleasant Creek eastwards to the Fault Range (**Map 2**) to better understand the movement patterns of the animals in this area. Captured caribou were affixed with Vectronic Aerospace Survey-2D collars programmed to take a GPS location every 5 hours 59 minutes and fitted with timed drop-off mechanisms scheduled to be released within five years of capture. These location data are transmitted via the Iridium satellite to the Vectronic Inventa web service providing locations daily to Fish and Wildlife Branch biologists. This additional collaring program was done in collaboration with Habitat Programs, who provided scouting prior to the captures during their Upper Stewart Caribou WKA survey in 2020. A summary of all GPS satellite collar locations by individual from 2016 to 2024 is available in **APPENDIX 1**.



Map 2. Location of collar deployments in the Tay River region from 1982 to 2020.

Tay River herd fall composition surveys (2016–2019)

It is important to analyze long-term trends in calf recruitment and adult sex ratios to gain a comprehensive understanding of the herd's overall trajectory, as annual estimates may vary considerably (Environment Yukon, 2016). To estimate the composition (number of calves, cows, and immature and mature bulls) of the Tay River herd, fall rut composition surveys are flown in high elevation rutting terrain throughout the herd's range during September/October to obtain a sample of individuals from which to estimate composition. Once a group is located, animals are pursued briefly to enable experienced classifiers to view the animals' rumps to confirm the presence of a vulva patch, penis sheath, testicles, rump size and shape, and/or antler presence, size, and configuration. Rut composition surveys were conducted in the Tay River herd range from 2016 to 2019. In 2017, one of the mark-resight sessions classified animals in accordance with a typical composition survey.

Mark-resight population survey (2017)

Three discrete resighting sessions were conducted with three separate crews, from 28 September to 11 October 2017, using an A-Star 350D helicopter. Due to the size of the Tay River herd range, it was not feasible for all three crews to survey the entire range, thus the need for stratification. Prior to the survey, the survey blocks were stratified based on all available satellite-collar locations obtained during the rut. Blocks were qualitatively identified as High, Medium, or Low priority, or excluded. The goal was for all three crews to fly High blocks, with Medium blocks flown by at least two crews, and Low blocks flown by at least one. Excluded blocks were not surveyed and did not have any marked animals located in them. The Moose Lake herd range consisted of two blocks, which were both flown by all three crews. In total, 57 blocks were delineated as High, Medium or Low (**Map 1**). Each block was also assigned a survey time in minutes to ensure each crew surveyed with roughly the same effort.

Marked animals were considered "available" to be observed if those animals were within the blocks during each crew's resighting session. Since the crews did not survey all of the same blocks, not all marked animals were available for each crew. Failing to account for this would bias the resighting rate low, thus inflating the population estimate. This availability was determined by using collar locations after surveys were complete. Crews did not know which marked animals were present in a block during their survey, and no telemetry equipment was used to locate animals as that would bias the resighting rates high. Whenever a group of caribou was observed during the resighting surveys, a total count was obtained, caribou with visibility-bands were identified using the unique visibility-band colour and number combination, and the total number of marked animals recorded. During the third resighting survey, animals were also classified as calves, cows, immature and mature bulls, as per a typical fall composition survey.

Data analysis

To estimate herd size, an analysis was conducted in Program MARK, version 8.1, using the mixed logit-normal mark-resight model (McClintock & White, 2012) for the Moose Lake herd and the mixed-logit immigration-emigration logit normal model for the Tay River herd. Since the entire Tay River herd range was not surveyed during each resighting session, the immigration-emigration logit normal model was used as a proxy for not all marked animals being available during each session. The model estimates both the population that actually *resides within* the study area during the period of interest (N), but there is also a "super-population" estimate (N*) derived that represents individuals *associated with* the study area during the period of interest. In the case of the Moose Lake herd, all marked animals were available during each session and it was assumed to be geographically and demographically closed across all three resighting sessions. Both models allow for heterogeneity in individual resighting probability by essentially treating each animal as a random effect. Preliminary analyses indicated this could not be estimated and was thus fixed to 0 for final analyses.

The immigration-emigration logit normal mark-resight model has five estimable parameters:

- **p** – resighting rate;
- **σ** – individual heterogeneity in resighting rate;
- **N** – population size in the survey area;
- **N*** – super-population size, and
- **α** – change in **N** between resighting sessions.

A set of candidate models were developed by varying parameters and comparing each using Akaike's Information Criterion difference ($\Delta i\ AIC_c$; (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 plausible (Richards, 2005) (Symonds & Moussalli, 2011).

Distribution assessment (1982–2024)

A desktop assessment of animal distribution in the Tay River region was conducted to gain a better understanding of the seasonal movements and distribution of caribou, and to identify any obvious trends or shifts in range use over time. We looked at the capture and seasonal locations of individual animals from 1982–1992, 2016–2018, and 2020–2024 collaring programs as well as past aerial survey locations throughout the current and historic Tay River herd range (**Table 1**).

In 2018, annual ranges for the Moose Lake and Tay River herds were developed using all collared individuals from the 2016/17 collaring program. To evaluate *recent* distribution of caribou in the Tay River area, we used GPS satellite collar locations from March 2016 to March 2024 (APPENDIX 1). All locations from each collared individual were visually examined to assign them to a population unit or herd, based on seasonal patterns in range use and movement. Individuals were assigned to either Tay

River, Moose Lake, Hess River, Redstone or unassigned (APPENDIX 1). Unassigned individuals were those that displayed inconsistent or varied movement patterns throughout the study period that were not typical of any herd. The exercise of assigning individuals to herds is somewhat subjective; however, it is necessary for defining population units from which management and monitoring decisions are made. Population units or herds are not static over time, with new information regularly improving our understanding of space use patterns and animals displaying plastic behaviours that are likely beneficial to survival and gene flow. Annual ranges were generated by using the kernel density estimation (kde) method of utilization distribution (UD) with smoothing parameters estimated via the reference method to estimate the 95% utilization distribution of collar locations and manually modified to follow terrain features where appropriate (i.e., ridges or valleys).

To explore seasonal distribution, collar locations were categorized into the following seasons:

- Spring migration → 16 April to 14 May
- Calving → 15 May to 15 June
- Summer/post-calving → 16 June to 15 September
- Fall rut → 16 September to 20 October
- Winter → 21 October to 15 April

For Tay River animals, in all seasons except for spring migration, locations were pooled across individuals and subsampled to one location every three days to reduce issues with autocorrelation (lack of independence of successive observations). These data were then used to estimate population-level seasonal ranges using the kernel density estimation (kde) method of utilization distribution (UD) with smoothing parameters estimated via the reference method to develop polygons that represent probability of use based on density values. This resulted in estimations of the 50% and 95% utilization distribution of collar locations. The resulting seasonal ranges represent an estimation of herd distribution; however, these data are limited to a sample of female caribou and do not reflect predictions of what space will eventually be used, given enough time for the movement process to continue. We did not use kernel density estimation for the Moose Lake and Hess River groups, as the areas used seasonally differ minimally and sample sizes of collared caribou were relatively low. To represent spring migration, all collar locations from 16 April to 14 May were used to create lines to better represent travel paths. Individual travel paths were buffered by 400 m on each side (800 m in total) to account for movement uncertainty (i.e., deviation from the path between fixes) resulting from variable GPS fix rates (Merkle, et al., 2023).

Table 1. Location data used to evaluate distribution and herd assignment for caribou in the Tay River and Upper Stewart River areas.

Data	Data availability	Number of groups or locations (# collars deployed)	Data collection details
VHF radio-collar relocations	• Mar 1982 to Mar 1983 • Feb 1989 to Mar 1992	• 10 (3 collars) • 267 (27 collars)	• 15 relocation flights • Represents Moose Lake and Tay River herds
GPS satellite-collar locations	• Mar 2016 to Nov 2018 • Oct 2020 to Mar 2024	• 20,774 (39 collars) • 50,790 (15 collars)	• Various fix rates (2.5–13 hrs) • Represents Moose Lake, Tay River, Redstone herds
Late winter survey	• Mar 2009	• 50 groups	• Southern portion of Tay River herd
Fall rut surveys	• Oct 1991 • Sept 2003 • Oct 2016 • Oct 2017 • Oct 2018 • Sept 2019	• 13 groups • 13 groups • 63 groups • 270 groups* • 56 groups • 58 groups	• Represents Moose Lake, Tay River, Redstone herds • *Mark-resight survey, 3 resight sessions
Population estimates	• Mar 1991 • Sept/Oct 2017	• 266 groups • 270 groups	• 1991 stratified random block survey • Mark-resight survey, 3 resight sessions
WKA surveys	• Sept/Oct 2018–2022	• 83 groups	• Upper Stewart River area (Hess River and Redstone herds)

Results

Population estimates

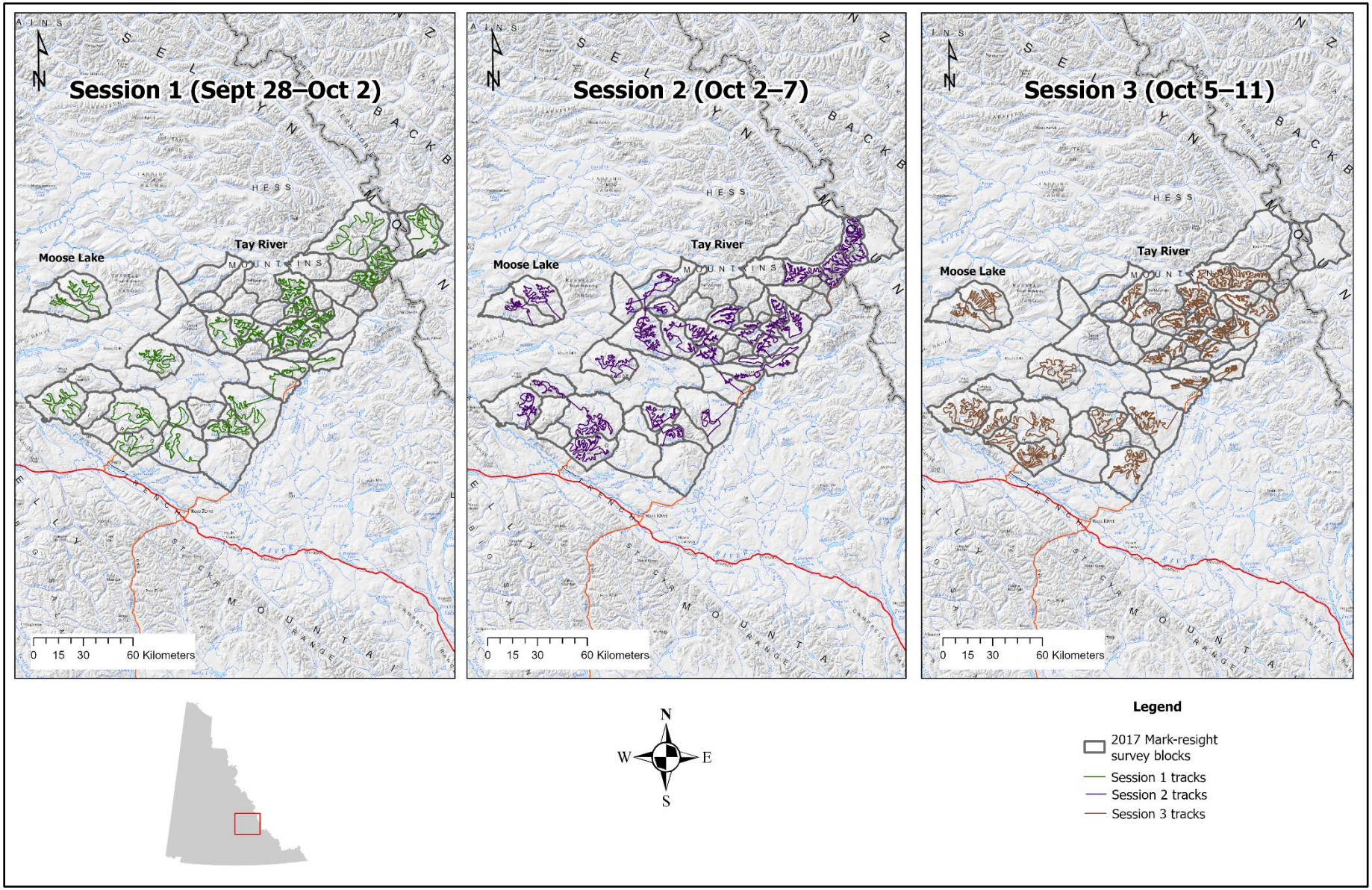
Weather conditions during the census survey were partly cloudy, with some low clouds and fog hampering sightability over some high elevation areas during Session two. Of the 39 collars deployed on both herds, collar malfunctions, natural mortality, and one animal who moved to the Finlayson caribou herd range reduced this number to 29, with 27 present in the Tay River herd and two in the Moose Lake herd at the time of the survey. During the survey, 20–23 collared Tay River animals were available for each resight session, and both Moose Lake collars were available for all three sessions. These values reflect that not all collars were available evenly across sessions and depend on which blocks were surveyed during each session (i.e., not all Medium and Low priority blocks were surveyed in every session). Some observations of caribou in survey blocks on or across the Yukon-NWT border were censored from the final analysis, as these were large groups (200+ animals) associated with the larger Redstone herd. Resighting rates (across both herd survey areas) ranged from a low of 18% during session two to a high of 52% during both sessions one and three (**Table 2**; **Map 3**). Total caribou observed ranged from 551 to 637 in the Tay River herd survey area, and 43 to 91 in the Moose Lake herd survey area, with group sizes ranging from 1 to 161 and 2 to 84, respectively (**Table 2**; **Map 3**). The top selected model for the Tay River and Moose Lake herds included resighting rates (*i.e.* recapture probability) for Sessions 1, 2, and 3 fixed at 0.52, 0.18, and 0.52, respectively (**Table 2**). The final 2017 population estimate for Tay River is **1,880 animals (95% CI: 1,735–2,112)**, and the first formal estimate for the Moose Lake herd is **173 animals (95% CI: 158–191**; **Table 3**). The Moose Lake herd's range was expanded in 2024 to include a group of animals behaving similarly (limited, localized movements) north of the Hess River. It is estimated there are less than 200 animals in this group, thus bringing the combined population estimate for the Moose Lake herd to approximately **400 animals**.

Table 2. Survey results for the Tay River and Moose Lake resighting surveys, September–October 2017.

Resight session	Survey effort (hours flown)	Total marked caribou available (Tay/Moose)	Total marked caribou observed (Tay/Moose)	Total unmarked caribou observed (Tay/Moose)	Resighting rate (both herds)
1 (28 Sept–2 Oct)	19	**23**/2	**13**/1	**570**/90	0.52
2 (2–7 Oct)	20	**20**/2	**3**/1	**549**/42	0.18
3 (5–11 Oct)	21	**21**/2	**12**/0	**625**/80	0.52

Table 3. Estimates of model parameters of the Tay River and Moose Lake caribou herds from the most supported mark-resight model.

Herd	Top model	Parameter	Value	SE	95% Confidence Interval
Tay River	**N, N*, p_t, α., σ=0**	**N** (population within survey area)	1,487	26	1,438–1,539
		N* (super-population)	**1,880**	**94**	**1,735–2,112**
		α (change in N between sessions)	127	16	96–158
Moose Lake	**N, p_t, σ=0**	**N** (population size)	**173**	**26**	**158–191**



Map 3. Flight lines from all three sessions of the 2017 mark-resight population survey of the Tay River and Moose Lake herds.

Herd composition

During Session 3 of the 2017 mark-resight survey, the composition of the Tay River and Moose Lake herds was also estimated by classifying animals into bulls, cows, and calves (**Table 4**). A stable population growth rate requires 20 to 25 calves per 100 cows, according to the *Science-based guidelines for management of Northern Mountain caribou in Yukon* (Environment Yukon, 2016). The calf to cow ratios of 26 calves per 100 cows for Tay River and 24 calves per 100 cows for Moose Lake resulted in an estimated 282 and 26 calves within each herd, respectively (**Table 5**). An adult sex ratio of 30 bulls per 100 cows is considered adequate to ensure that all females have the opportunity to reproduce (Environment Yukon, 2016).The bull to cow ratios were 48 bulls per 100 cows for the Tay River herd and 36 bulls per 100 cows for the Moose Lake herd, resulting in an estimated 518 and 39 bulls in each herd, respectively (**Table 5**).

Single-year estimates of calf recruitment and adult sex ratios have limited inference, as these values can vary considerably from year to year, thus it is important to consider long-term trends when available. From 2016 to 2019, four fall composition surveys were conducted within Tay River rut range, including the third resight session of the mark-resight population survey in 2017 (**Table 6**). The averaged values suggest the Tay River herd was likely stable, with calf recruitment averaging 24.8 calves per 100 cows and adult sex ratios averaging 41.8 bulls per 100 cows (**Table 6**).

Table 4. Observed composition of the Tay River and Moose Lake caribou herds, October 2017.

Survey	Calves per 100 cows	Bulls per 100 cows	Number of caribou classified	Number of caribou unclassified
Tay River, resight #3	26	48	637	0
Moose Lake, resight #3	24	36	80	0

Table 5. Estimated composition of the Tay River and Moose Lake caribou herds based on estimated age and sex ratios and population estimates, October 2017.

Survey	Estimated herd size	Calves	Cows	Bulls
Tay River, resight #3	1,880	282	1,080	518
Moose Lake, resight #3	173	26	108	39

Table 6. Observed composition of the Tay River caribou herd, September/October 2016–2019.

Survey	Calves per 100 cows	Bulls per 100 cows	Number of caribou classified	Number of caribou unclassified
2–5 October 2016	23.4	32.0	870	0
5–11 October 2017	25.8	48.8	637	0
6–9 October 2018	23.9	38.4	516	0
28–29 September 2019	26.1	48.2	495	4
Average (2016–2019)	**24.8**	**41.8**	**630**	**1**

Distribution (1982–2024)

1982–1989 Collar Locations

Collars deployed on Tay River and Moose Lake caribou from 1982–1989 were monitored seasonally via fixed-wing aircraft to evaluate distribution. The results of this monitoring showed that the Moose Lake animals behaved differently than the Tay River animals by making limited, localized movements in the Plateau Mountain area, located south and east of Moose Lake, providing justification for considering them a separate herd (**Map 4**). In contrast, Tay River animals moved out of the alpine and into the lowlands in early winter, and during the calving season some individuals traveled north of the Hess River along the Rogue and Lansing rivers (**Map 4**). The north-south movements of a subset of Tay River animals were documented by Kuzyk and Farnell (1997), who suggested that these animals may be somewhat independent of the rest of the Tay River herd that wintered further south, near Faro. When examining the movement patterns of caribou captured in the southern part of the range versus ones captured further north, there appears to be a distinct difference in how these animals use the herd range. Caribou captured in the northern part of the range tended to remain north of the South Macmillan River up to the Tasin Range, while those captured in the southern part were more commonly distributed south and east of the Hess River to the North Canol Road (**Map 4**).

2016–2018 Collar Locations

The animals collared in 2016–2017 generally occupied areas that can be described as the core Tay River winter range north of Faro, exhibiting similar behaviour to the animals that stayed in the southern part of the range in the 1990s (**Map 5**). None of the caribou collared during this program went north of the Hess River into the Lansing Range. In spring 2016, one collared individual (TRCH1612) moved from winter range near Twopete Mountain east of the North Canol Road, calving south of the Prevost River, then moved further south into the Finlayson herd winter range, where she remained until July 2018 before making a westward movement back into Tay River range, into the mountains north of Tay Lake until her collar failed in September 2018 (**Map 5**). This provides evidence that some animals from the Tay River and Finlayson herds mix and highlights the challenge of assigning individuals to specific herds. Another individual (TRCH1633), displayed seasonal movements in both Tay River and Hess River

ranges, spending one winter in Tay River winter range north of Faro and another up north of Fairweather Lake, where she remained through the next spring to winter (**Map 5**). This area of the Tay River and the Moose Lake annual ranges (around Fairweather Lake and Husky Dog Creek) represents an area used by both herds. The Moose Lake animals behaved similarly to the first collaring program by making small, localized movements throughout the year in the mountainous regions above Moose Lake (**Map 5**).

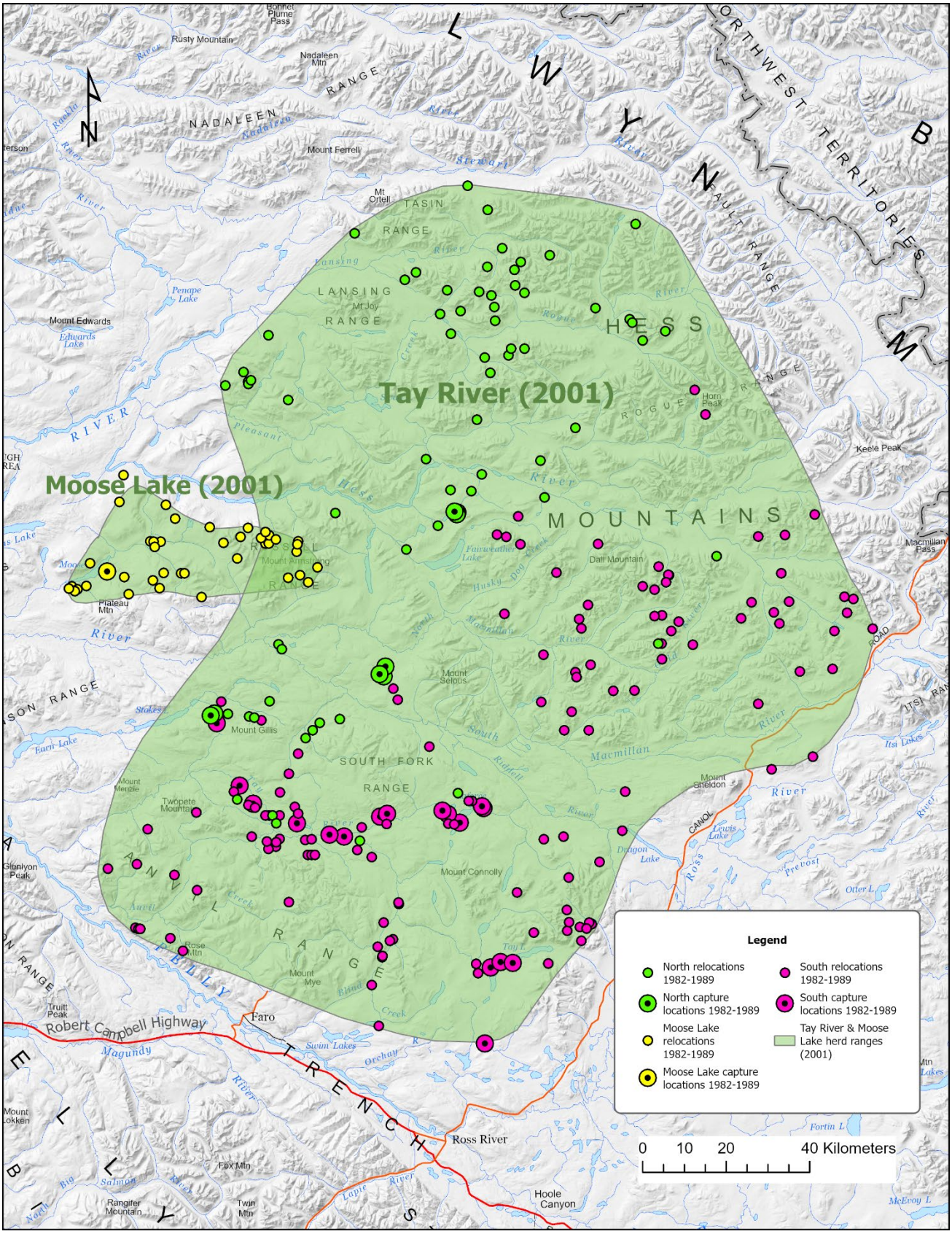
2020–2024 Collar Locations

Of the 15 caribou captured in 2020, eleven made large east-west movements along river valleys to the northeast, and are believed to be Redstone animals, while the other four animals displayed localized movements north of the Hess River, with one animal traveling south for the early winter and then back north of the Hess River during late winter (**Map 6**). The movements of these animals in the northern part of the range support previous observations by Kuzyk and Farnell (1997), and suggests that this may be a distinct sub-group of animals, similar to Moose Lake, as they have very little interaction with the much larger Redstone and Tay River herds and are displaying behaviours independent of the Tay River animals that range south of the Hess River (**Map 6**).

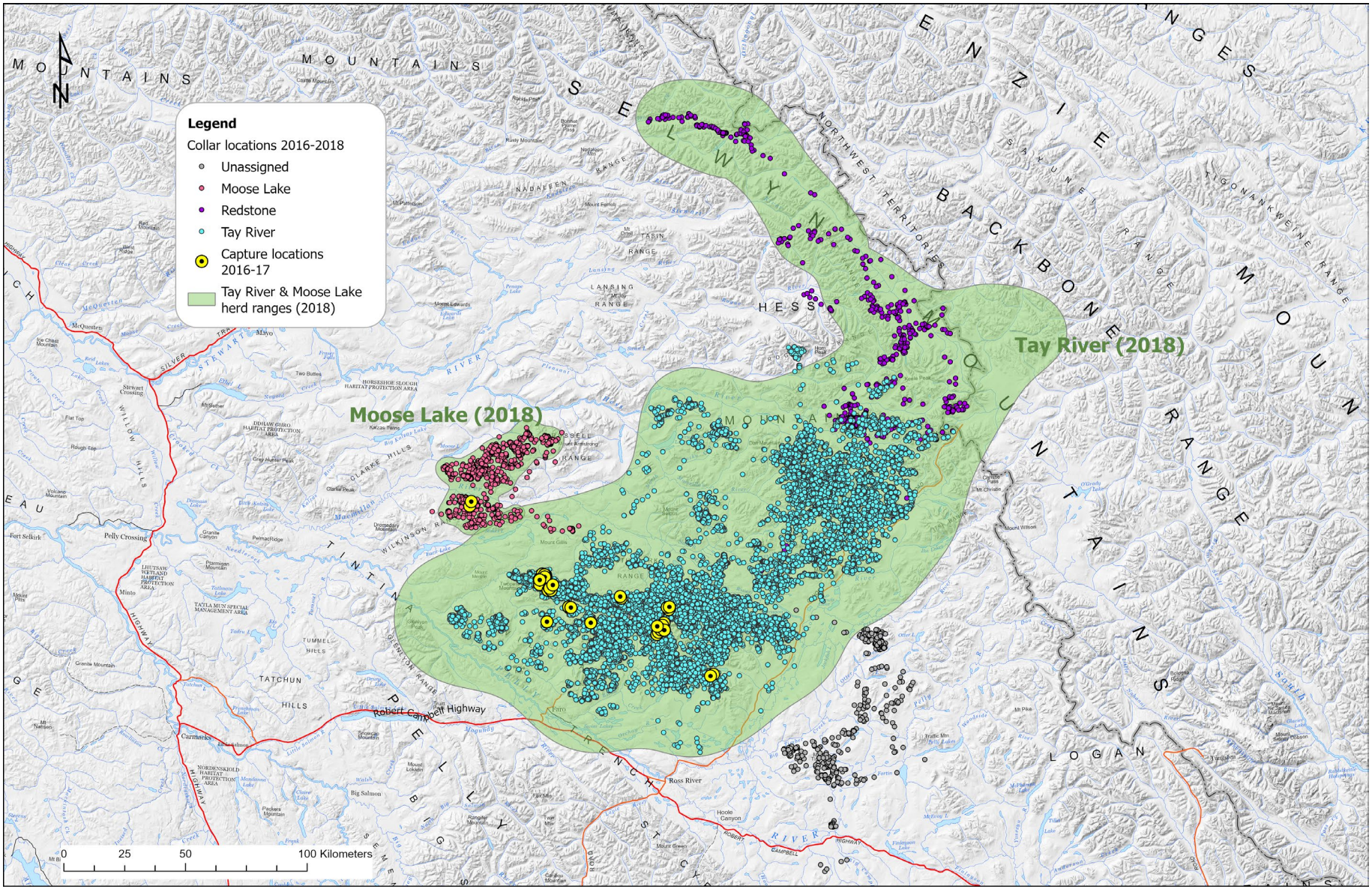
Fall Composition and Wildlife Key Area survey data

During fall composition surveys from 2016 to 2019, Tay River caribou were distributed in three main rutting areas: mountainous areas between the South Macmillan River and Macmillan Pass in the northeastern part of the annual range, between Tay Lake and Mount Connolly in the southeast part of the annual range, and high elevation areas on and north of Mount Mye (**Map 7**). Some smaller groups were also located north of the Tay River in the South Fork Range Mountains, east of Husky Dog Creek, and northeast of Keel Peak (**Map 7**). Group sizes ranged between 1 and 94 individuals.

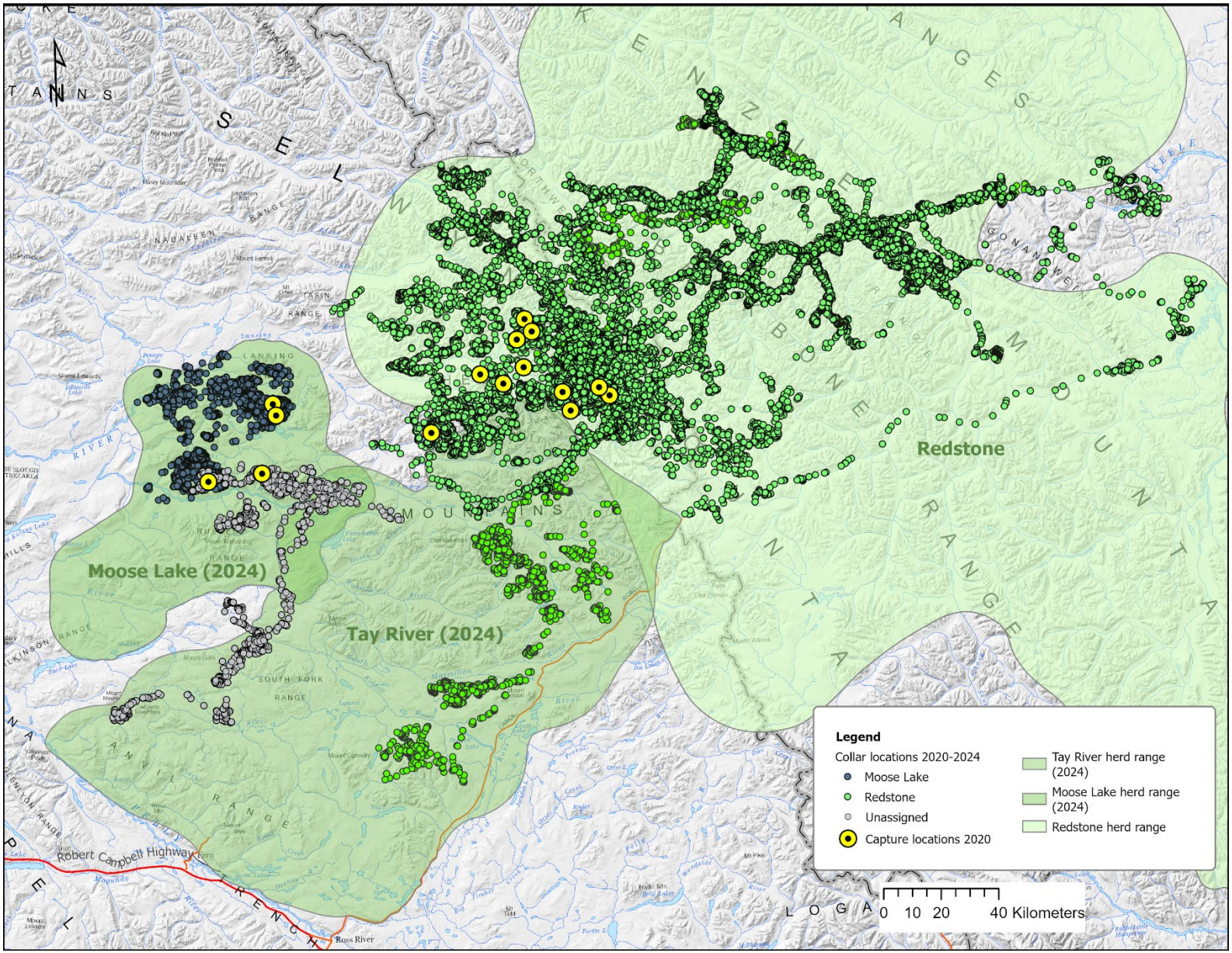
WKA surveys were conducted in the Upper Stewart River watershed during late September/early October 2018–2022 to map the distribution and rutting habitats of caribou in this area and to evaluate abundance of caribou in the northern part of the previously mapped Tay River caribou herd range (O'Donoghue & Potié, 2023). Caribou observed during these surveys largely aligned with the collar data (**Map 6**), with a small number of caribou (48 animals) observed in the northern part of the Moose Lake range, in the subalpine and alpine around Swan Lake, and a larger concentration of caribou (695 animals) were recorded along the ridges around Horn Peak and the Fault Range, consistent with that of the Redstone herd (**Map 7**).



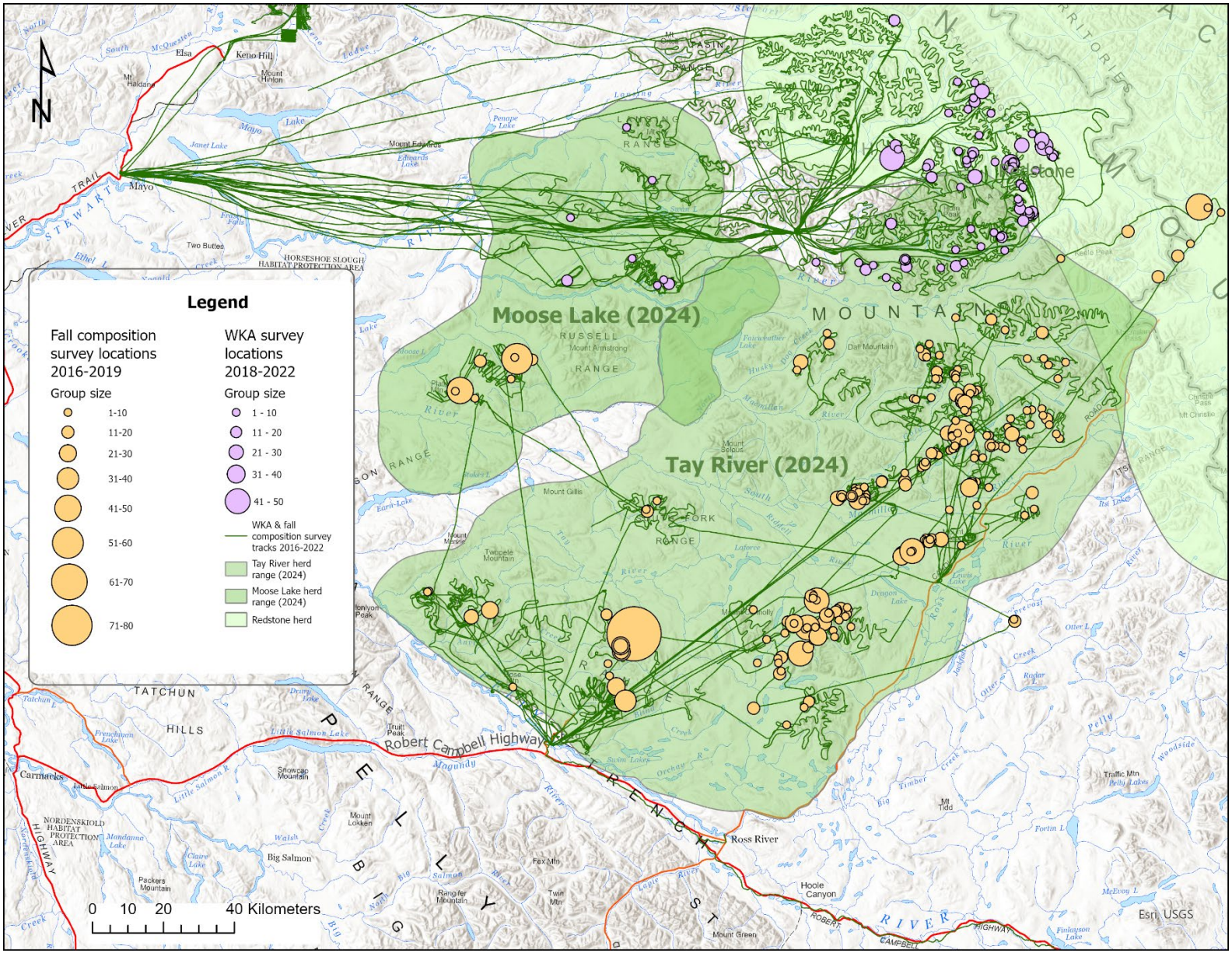
Map 4. Capture locations and collar relocations in the north and south part of the Tay River annual range, 1982–1989.



Map 5. Capture locations and collar relocations in the Tay River and Moose Lake area, 2016–2018.



Map 6. Capture locations and collar relocations in the Upper Stewart River area, 2020–2024.



Map 7. Fall composition (2016–2019) and Wildlife Key Area (2018–2022) caribou survey track lines and locations.

Current Annual and Seasonal Distribution

Based on the collar location data from 2016 to 2024 (APPENDIX 1), caribou were assigned to one of four herds or unassigned if their movement patterns did not align with any herd (**Table 7**).

Table 7. Herd assignments of collared caribou in the Tay River region, 2016–2024.

Herd	Number of collars assigned
Tay River	32
Moose Lake	2
Hess River (part of Moose Lake herd)	3
Redstone	15
Unassigned	2

Locations from individuals assigned to the Tay River, Moose Lake, or Hess River herds were used to generate updated annual herd ranges, which represent unique population units (**Map 6**). The annual range for Moose Lake was combined into a single population unit with the Hess River animals, primarily due to their geographical proximity, similar movement ecology (characterized by limited localized movements), and relatively low density of animals on the landscape. It is possible that other small, low-density groups with limited movement patterns, like Moose Lake and Hess River exist in this region and the extent of these combined ranges will undoubtedly change over time. An annual range for the Redstone herd was not updated, as this study was not representative of the herd's overall distribution and represents a relatively small number of individuals (15) compared to the estimated herd size of 10,000 (Environment Canada, 2012).

Tay River herd

Most animals from the Tay River herd displayed a consistent movement pattern from their winter range located between the valleys northeast of Faro and the South Macmillan River, northwards to mountainous terrain between Gold River and the North Canol Road in the spring (**Map 8**). Animals most often moved along the South Macmillan River as it turns northwards, highlighting a very important movement corridor between the two seasonal ranges (pink paths; **Map 8**). Some individuals (n=3) demonstrated a circular pattern of movement throughout the year, moving northeast towards the mountains west of the North Canol Road in spring like the majority of Tay River animals. Towards fall and early winter, they moved westwards towards Fairweather Lake before returning south to their winter range along major river valleys in the western part of the herd's range (blue paths; **Map 8**).

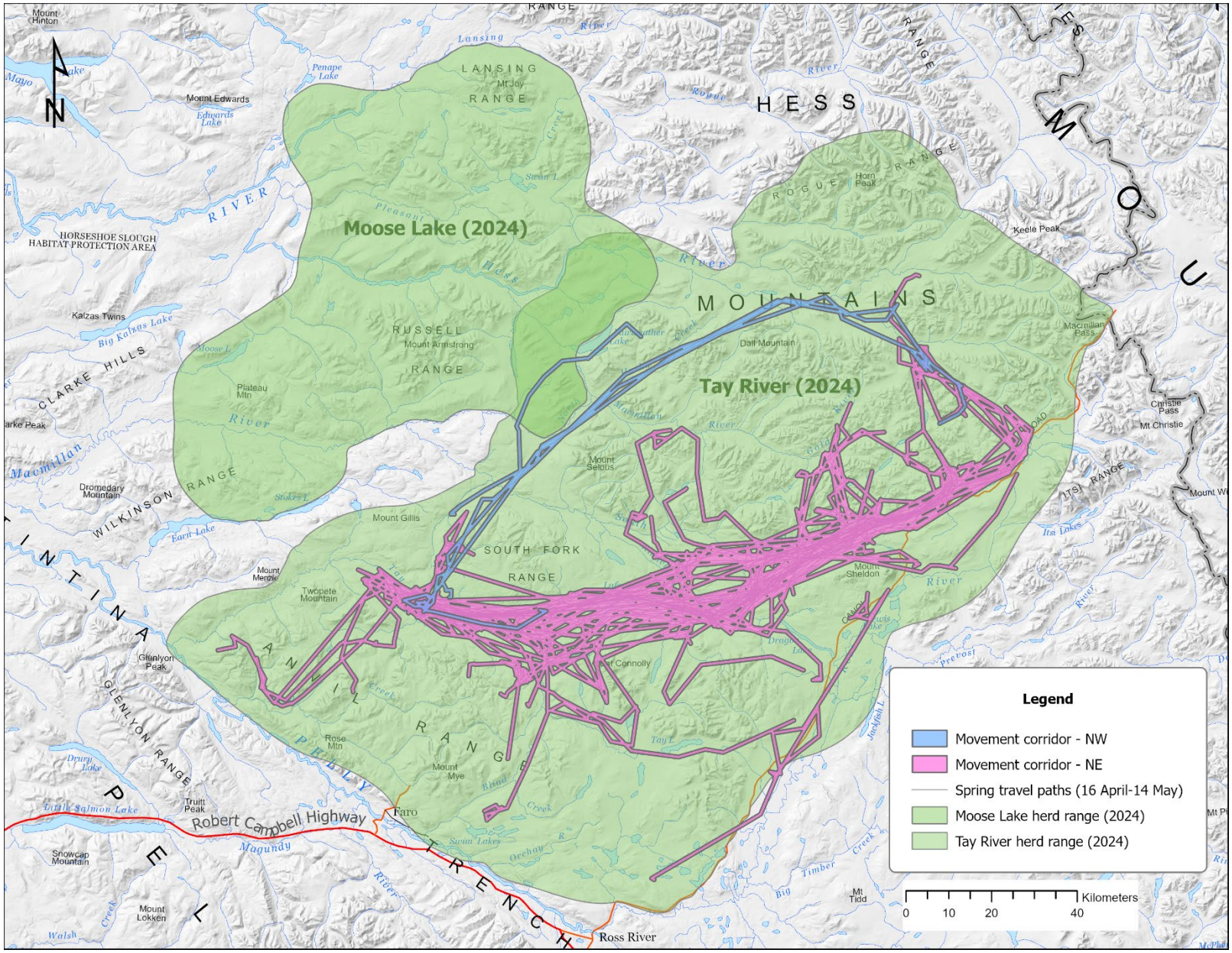
Caribou from the Tay River herd generally stay in the mountainous area west of the North Canol Road from calving until the fall rut. Calving ranges are typically dispersed for Northern Mountain caribou; however, many animals from the Tay River herd appear to calve in a concentrated area centered between the South and North Macmillan/Gold Rivers, around Ollie Lakes (**Map 9**). Some individuals remain south of the South Macmillan and Riddell Rivers, dispersing to calve in high elevation areas near Mount Mye, Dragon Lake, Rose Mountain, Mount Connolly, and the South Fork Range (**Map 9**). During

the summer/post-calving season, Tay River animals stay at higher elevations generally in close proximity to calving areas, but somewhat more dispersed (**Map 10**). During the rut, Tay River caribou gather in high elevation areas primarily around Gold River and north of the South Macmillan River, with other groups gathering in the mountains between Tay Lake and Connolly Lake, north and south of Anvil Creek (north of Mount Mye), Tay Mountain, and southwest of Anvil Lake (**Map 11**). During winter, Tay River caribou are quite concentrated in valleys and hillsides south of the South Macmillan and Riddell Rivers and north of Anvil Creek, Mount Mye and Mount Connolly (**Map 12**).

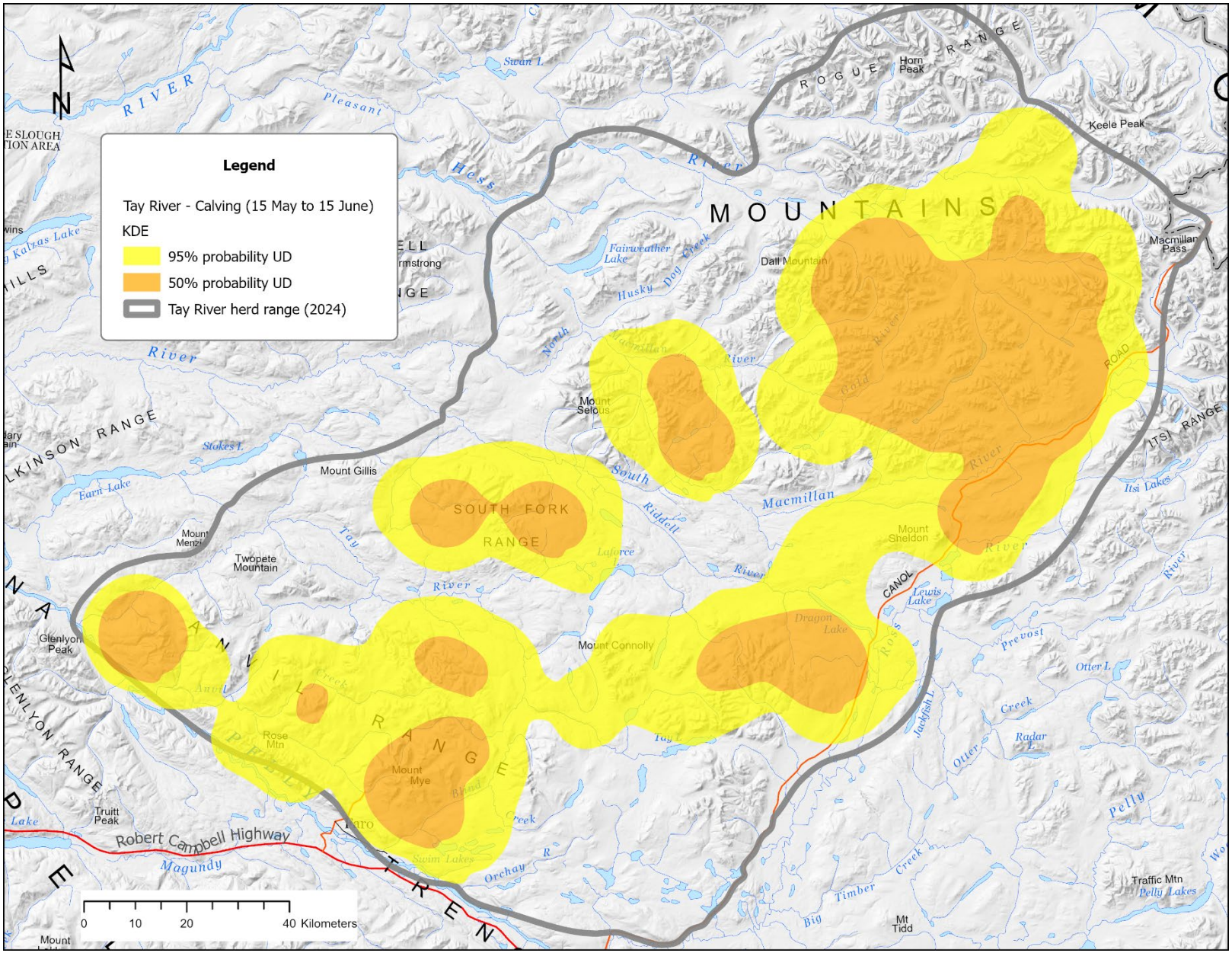
Moose Lake herd

Our understanding of caribou distribution in the Upper Stewart River region (Moose Lake and Hess River groups) is limited by relatively low sample sizes of collared animals due to the relatively low density of animals in this area and difficultly locating caribou in appropriate terrain for capture. From calving until fall, caribou in the southern portion of the Moose Lake herd range are found in higher elevation areas between the Macmillan River and the Hess River, primarily around Plateau Mountain and Mount Armstrong. During the rut, caribou collar and aerial survey locations are concentrated around Plateau Mountain, higher elevation areas around Limestone and Marion Creeks, and to a lesser degree around Mount Armstrong. During winter, animals may stay in the Plateau Mountain area or move south, across the Macmillan River to low elevation areas in the South Fork Range, north of Earn and Stokes Lake (**Map 13**).

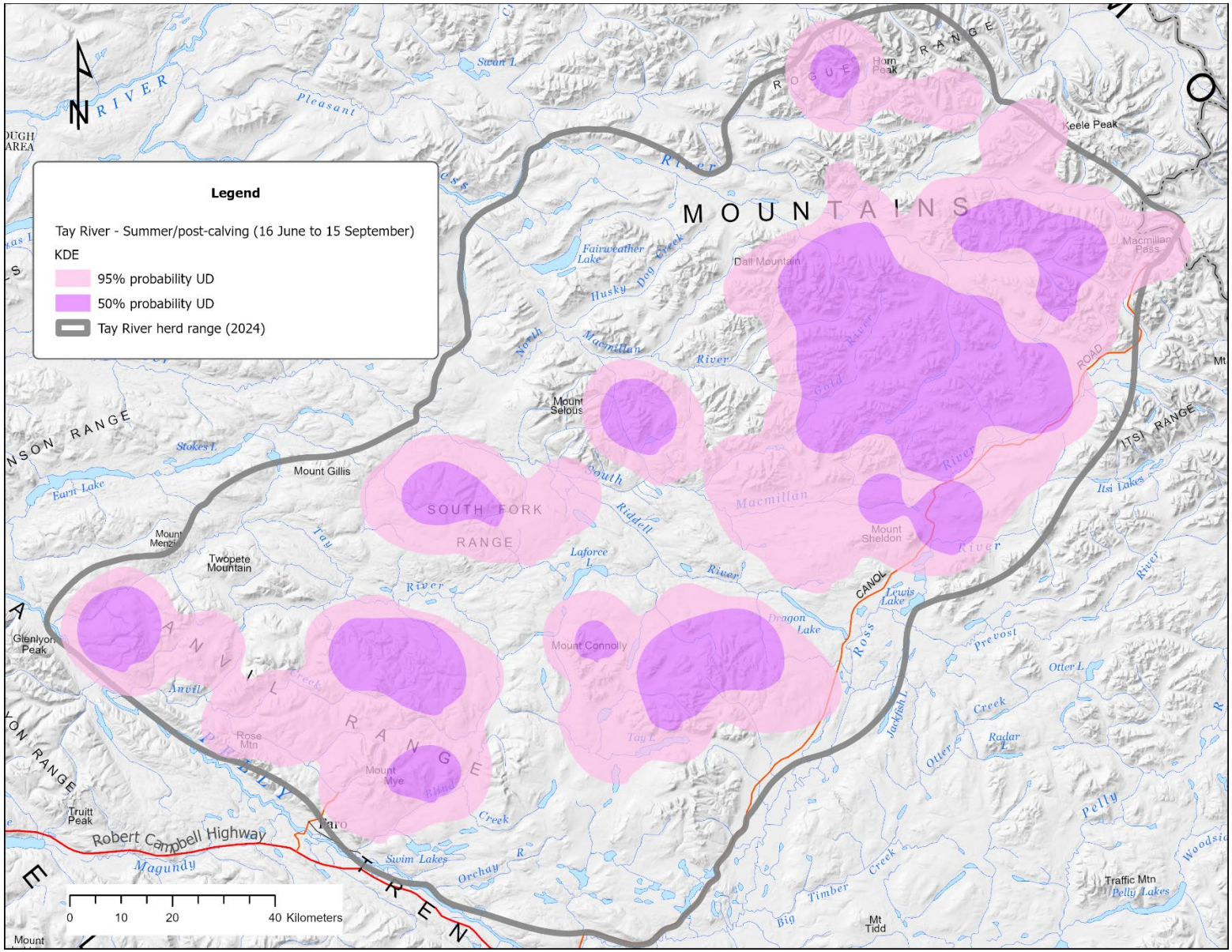
Caribou in the northern portion of the Moose Lake herd range are primarily located north of the Hess River and south of the Lansing River throughout the year. From calving to fall, animals spend time in high elevation areas immediately north of the Hess River, in the mountains north of Swan Lake, and Mount Joy. One individual did spend time in the Russell Range Mountains immediately south of the Hess River. During rut, animals were in these same general areas, except those who summered on Mount Joy move south to the mountains above Swan Lake. During winter, Hess River animals moved into low elevation areas between the Hess River and Pleasant Creek, the east side of the Stewart River, and north of Pleasant and Swan Lakes (**Map 13**).



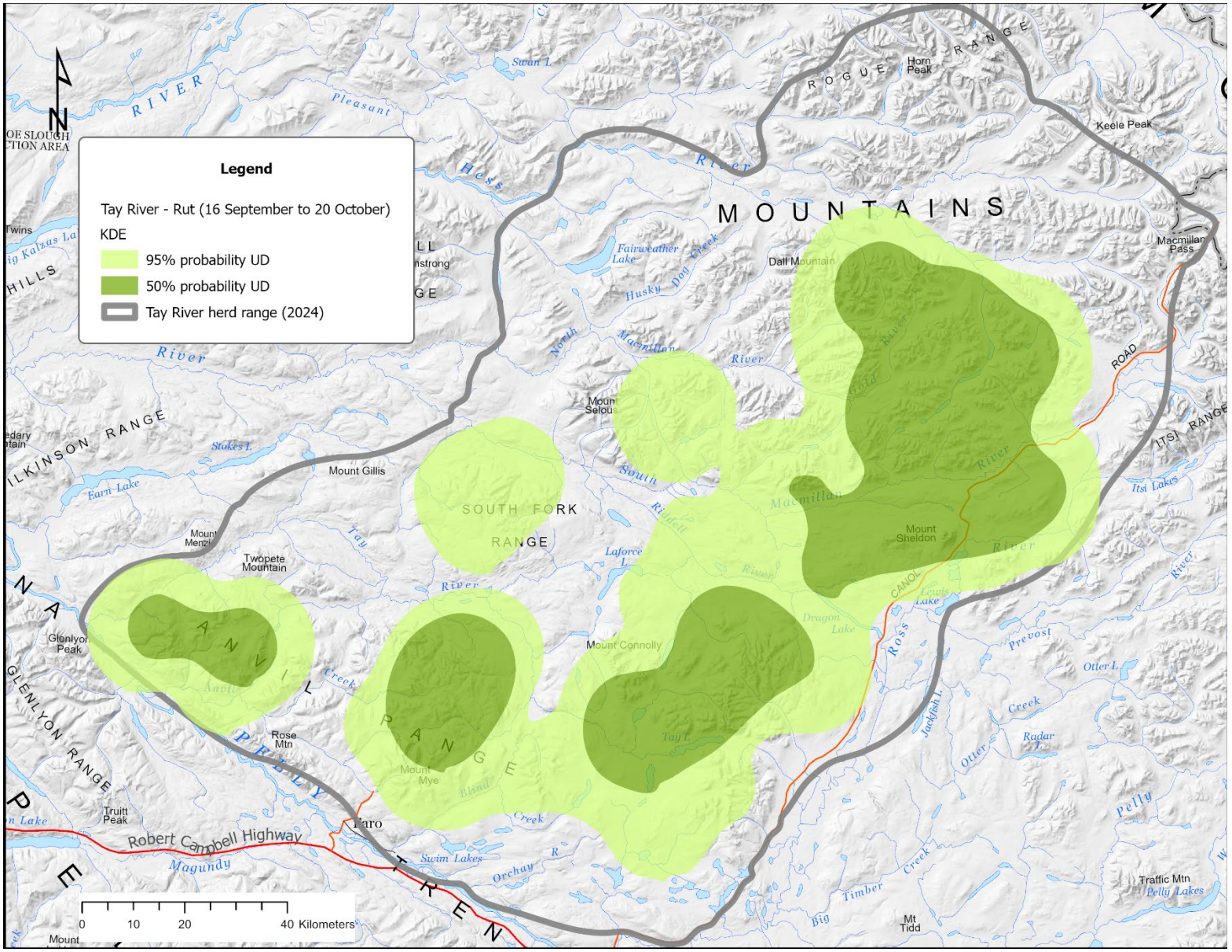
Map 8. Spring movement paths of caribou in the Tay River area, based on collar locations from 2016–2024.



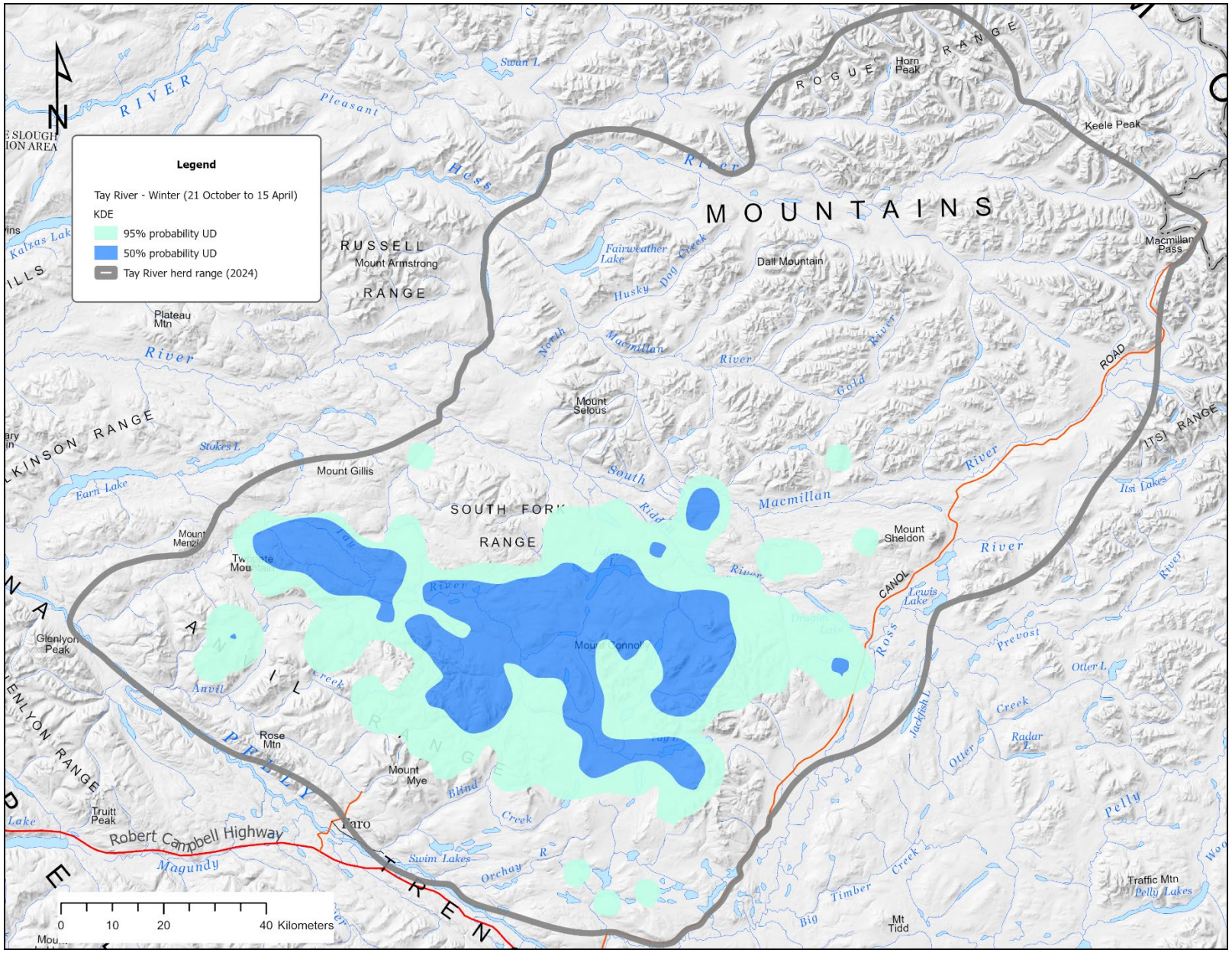
Map 9. Calving, (15 May to 15 June) of caribou in the Tay River area, based on collar locations from 2016–2024.



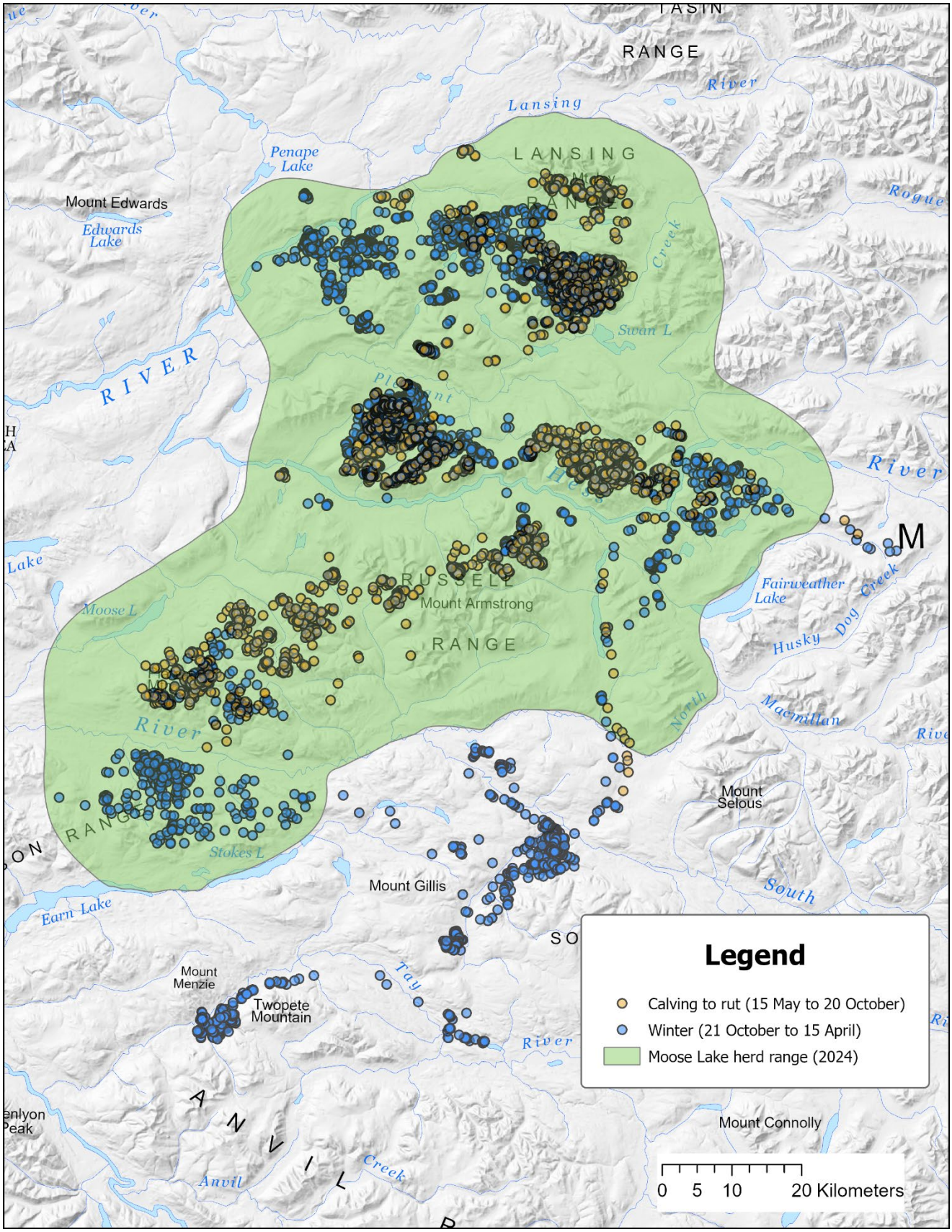
Map 10. Summer/post-calving distribution (16 June–14 September) of caribou in the Tay River area, based on survey and collar locations from 2016–2024.



Map 11. Rut distribution (15 September to 20 October) of caribou in the Tay River area, based on survey and collar locations from 2016–2024.



Map 12. Winter distribution (21 October to 15 April) of caribou in the Tay River area, based on collar locations from 2016–2024.



Map 13. Calving to rut and winter distribution of Moose Lake and Hess River groups, 2016–2024.

Discussion

During the previous population survey on the Tay River herd in 1991, a total of 3,144 caribou were observed, and the population was estimated at 3,758 animals (Kuzyk & Farnell, 1997). This greatly exceeds the 2017 population estimate of 1,880 and the total number of caribou observed during any of the resight sessions (high of 625 caribou observed; **Table 2**). There is uncertainty surrounding the comparability of these two estimates due to the time between surveys, different survey timing (winter vs. fall), methodology (stratified random block vs. mark-resight), and changes in our understanding of caribou distribution. These factors limit our ability to infer trends from the population estimates alone.

Given the apparent decrease in the herd's estimated size between 1991 and 2017, we suggest some or all of the following explanations, which are expanded upon below:

1. Slow herd decline for unknown reasons;
2. Reduced north-south movements by animals from north of the Hess River in summer and fall southwards to the main Tay River winter range due to wildfire activity in the early 2000's;
3. Exclusion of some Tay River caribou from the 2017 estimate due to overlapping with the Redstone herd during the fall rut. Large groups in these overlap blocks were censored from the analysis).
4. Movement between herds, where individuals from the Redstone herd may have joined Tay River animals on their winter range in 1991, inflating the population estimate.

The Tay River herd may have experienced a population decline between 1991 and 2017. Crews in 1991 counted a total of 3,144 animals on Tay River winter range during the stratified random block population survey; however, during the 2009 late winter distribution survey, crews observed a total of only 673 animals over the same area. Although the 2009 distribution survey was not as comprehensive as the 1991 population survey, this nonetheless demonstrates a considerable reduction in the number of observed caribou between the two time periods. Anecdotal information from an outfitting operation in the area indicated that back in the 1990s they saw "*…lots of caribou*," but by 2009 they had "*…noticed a decline in the number of caribou.*" This observation aligns with licenced harvest trends in the game management subzones that overlap with the Tay River herd (**Figure 1**), which demonstrates a declining trend in the number of caribou harvested by licenced harvesters since 1995. From 1995 to 2008, an average of 34 caribou were harvested each year, compared to an average of 15 between 2009 and 2023 (**Figure 1**). The same outfitter indicated that over the last three years (2020–2022 hunting seasons), his guides reported an increase in caribou numbers, particularly mature bulls. While the herd may have been declining over this period, changes in distribution may have also contributed to the

observed reduction between 1991 and 2017. Eight of the Tay River caribou collared in 2016/17 were lost due to mortality by 2017, suggesting female adult survival may be relatively low and supporting the notion of a herd in decline. Fall calf recruitment data from 2016–2019, however, are indicative of a stable herd trend (25 calves per 100 cows; **Table 6**). The significant time gap between surveys makes it difficult to understand the herd's status.

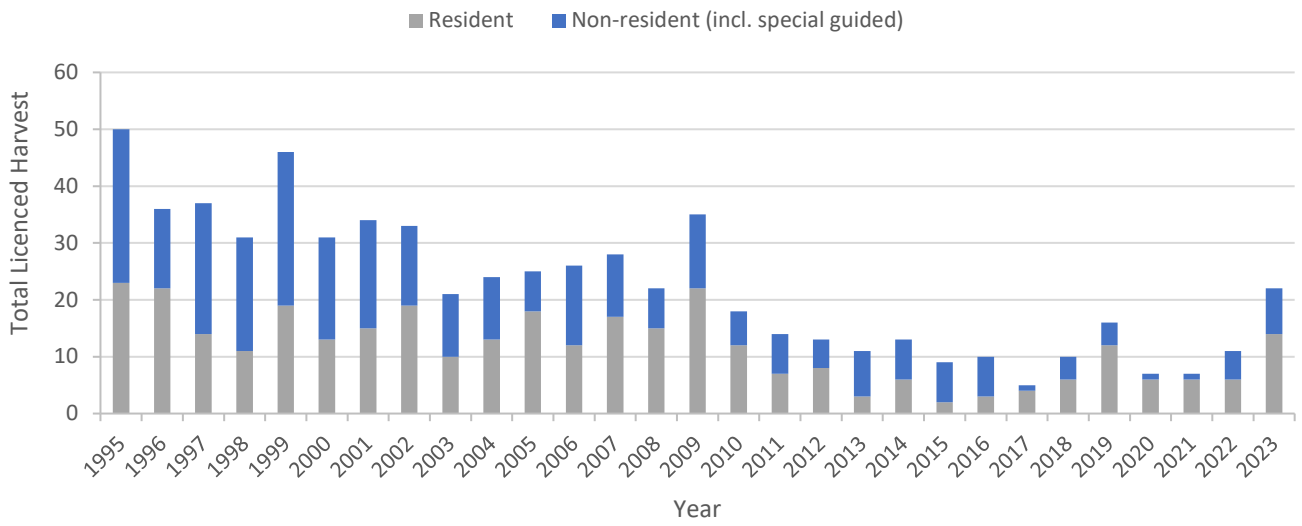


Figure 1. Total licensed harvest of Tay River caribou from 1995 to 2023, by residents (grey) and non-residents (blue) (non-resident harvest includes special guided hunts).

During the 2009 late winter distribution survey of the Tay River herd range conducted in the South Fork Range, south of the North Macmillan River (**Map 14**, right), the Liard Regional biologist at the time noted that:

> "*Many of the habitat areas formally known to be used by collared caribou in the Tay range have been altered by wildfire. It would be worthwhile to determine if this herd's winter range has shifted substantially or shrunk in response to recent fires.*" (Pretzlaw 2009; *unpublished note to file*).

It is evident from current location data (2016–2024) that the caribou distribution in the region is largely driven by the presence of recent (<50 years) wildfire (**Map 13**). In 2004, a large amount of area concentrated between the north side of the Hess River and the Tay River was burned. This area may have served as a movement corridor between the mountains in the Stewart Plateau (north of the Hess River) and winter ranges traditionally used by the Tay River herd, south of the South Macmillan River. One collared individual from the 2020 collaring program (TRCH2004) demonstrated this north-south movement pattern (**Map 6**), spending calving to early winter (~mid-December) in the mountain blocks immediately north and south of the Hess River, then moving southwards along a valley to south of the South Macmillan River where she spent late winters, until early May when she would move back

northwards up the valley towards the Hess River. Prior to the 2016 collar program, caribou location data in this region were not continuous in time (i.e., a single location per season or survey), thus it is difficult to know the degree to which this area was used as a movement corridor in the past, and how many caribou this may have affected.

Given that caribou avoidance of recent burned areas is well-documented (Thomas, Barry, & Alaie, 1996; Joly, Bente, & Dau, 2007; Russell & Johnson, 2019; Konkolics, Dickie, Serrouya, Hervieux, & Boutin, 2021), having to pass through these large burns may have deterred some caribou from travelling this north-south valley route after 2004, possibly resulting in more animals counted in the Tay River winter range during the 1991 population survey. Fire may have also resulted in redistribution of Tay River animals into areas historically considered the range of the Redstone or Bonnet Plume herds. Although the presence of wildfire undoubtedly influences the distribution of caribou in this region, and some animals may have been deterred from making this north-south movement post-2004, it is unlikely that this alone resulted in the difference in population estimates between 1991 and 2017.

Given the number of GPS satellite collars on the herd and the broad distribution of the survey blocks, it seems unlikely that large groups of animals would have been missed during the 2017 survey efforts. However, some observations of large rutting groups (200+ animals) on or across the Yukon-NWT border were censored from the 2017 population estimate, as they were assumed to be Redstone animals. Based on collar locations, we know that this area is a mixing zone for both herds, thus it is likely some Tay River caribou were not accounted for in these areas. Some Tay River individuals may have also been distributed further into the mountainous border region, beyond the 2017 survey area.

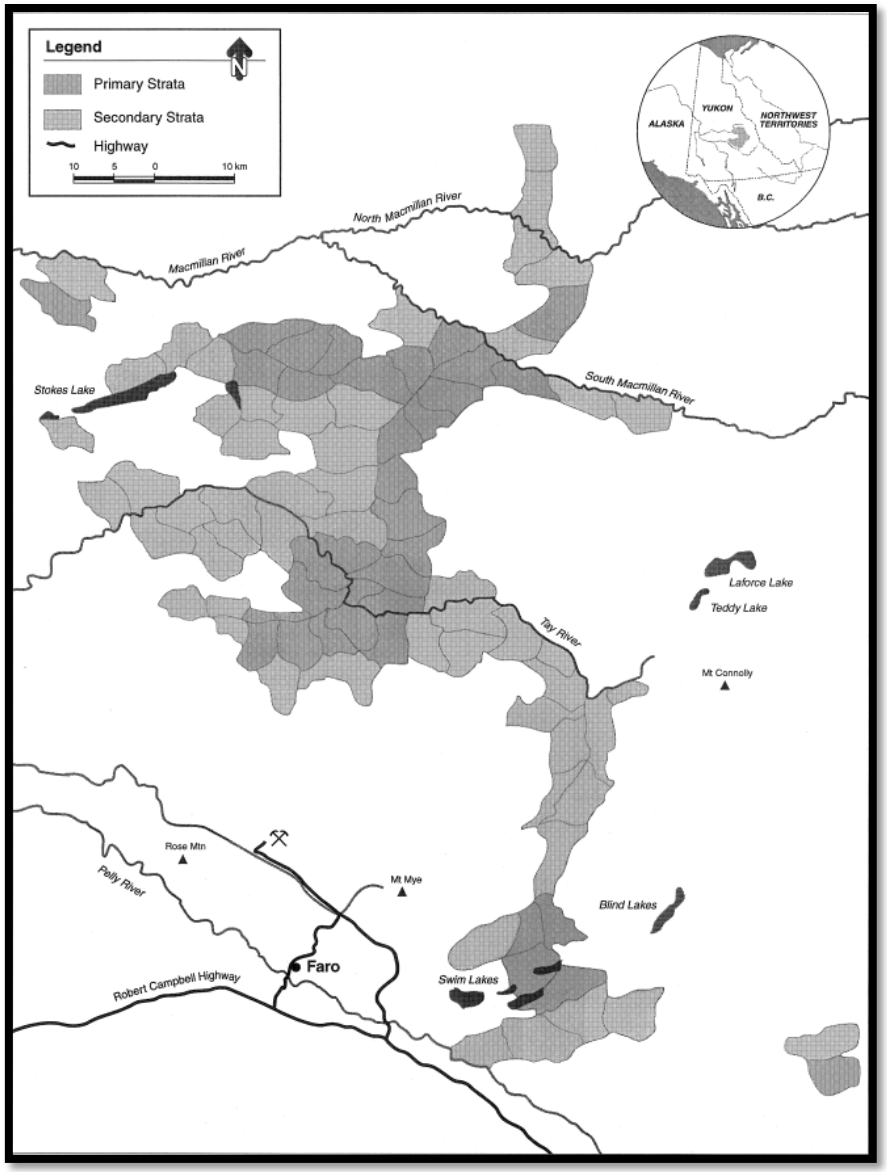
Both the 1991 and 2017 population surveys of the Tay River herd did not include areas north of the Hess River (**Map 1**; **Map 14**, left); however, Kuzyk & Farnell (1997) noted that:

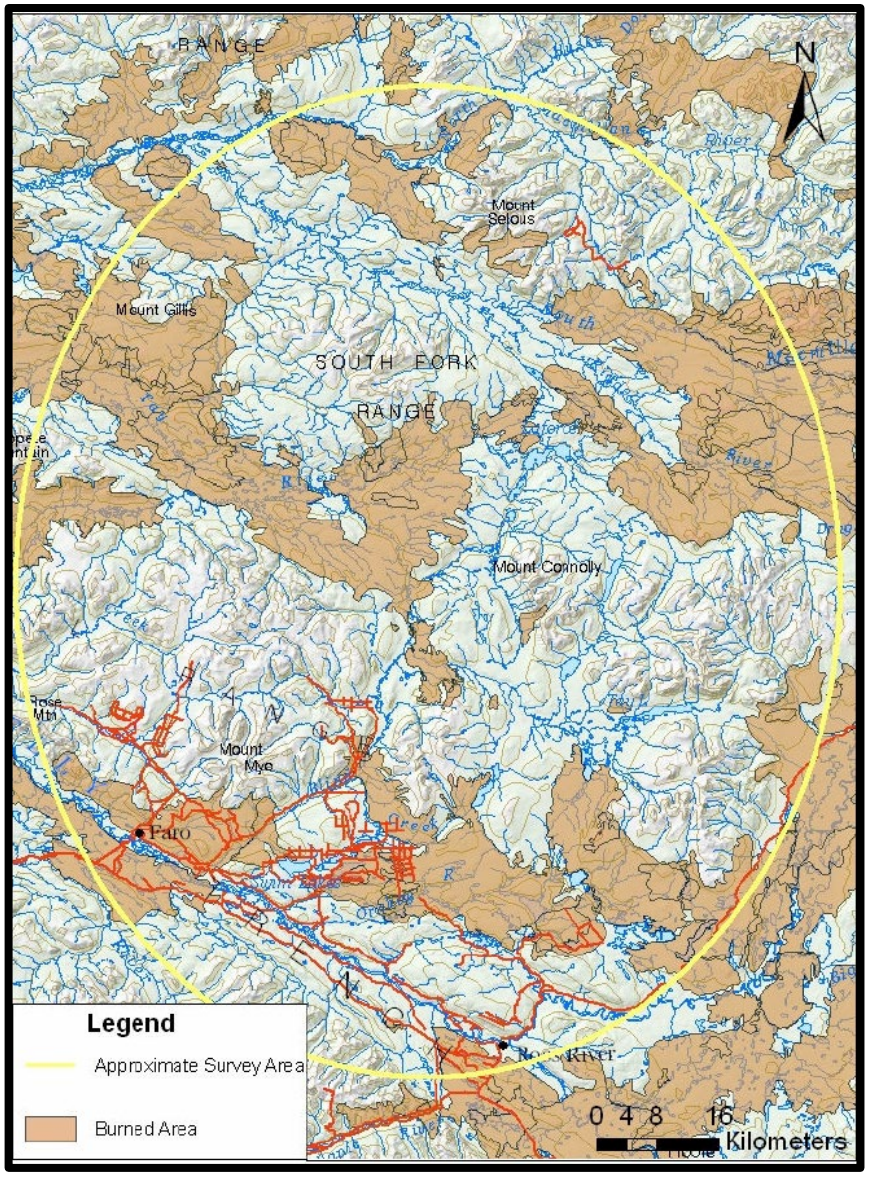
"*…a small group of caribou that spent the summer and fall north of the Hess River was found to move back to winter near the Hess River. It appears that they are somewhat independent of the larger winter concentration of caribou that winter north of Faro.*"

In 2017, the area north of the Hess River was not included because no recently collared animals were shown to use the area. During the 1982 to 1989 work, some individuals were captured along the north-south movement corridor used by the northern population (**Map 4**). This could explain why this initial collaring program described the Tay River herd as including the area north of the Hess River (**Map 4**). The 2016 collaring program focused capture efforts in March south of the Hess River, as an initial fixed-wing reconnaissance flight did not find any animals in suitable capture terrain north of the Hess River. Due to the timing of captures, even animals from the northern population moving into this area for early winter would have been missed.

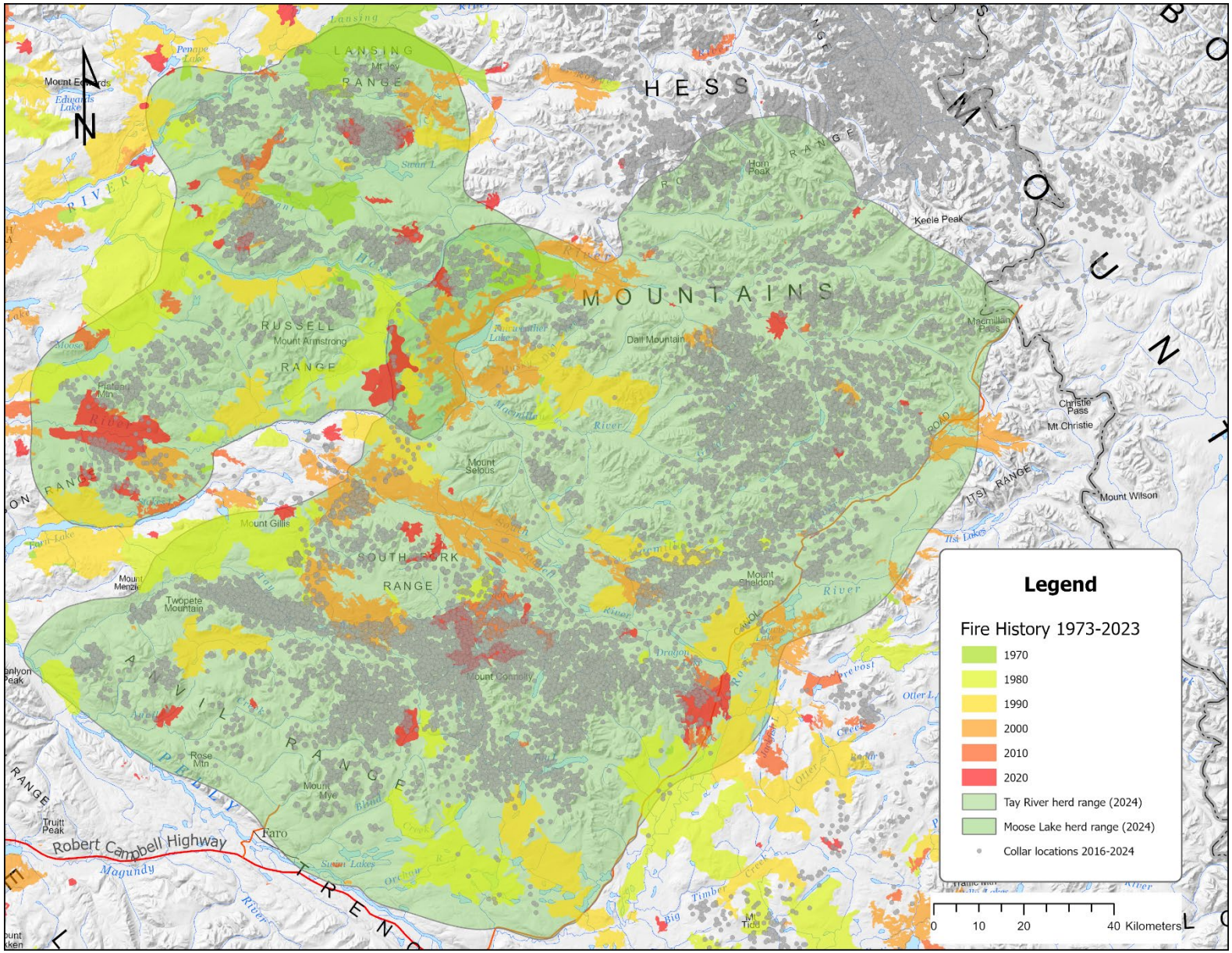
Based on the 2020 collaring program, Redstone animals are known to make long-distance movements during the winter season, usually along river or creek valleys in the mountainous border region; however,

one individual assigned to the Redstone herd spent one of three winters in Tay River winter range, moving as far south as the valleys north of Tay Lake (**Map 6**). This suggests some Redstone individuals could have been present in Tay River winter range during the 1991 population survey at a time when movement along the north-south corridor was less inhibited by recent wildfires.





Map 14. Survey area used to estimate population size of the Tay River caribou herd in 1991 (left) and general area covered during the 2009 late winter distribution survey (right).



Map 15. Recent wildfires in the Tay River region, 1973 to 2023, along with caribou collar locations 2016–2024.

**Note that some of the fires from the 2020 decade (red) may have occurred after collar locations were collected.*

Moose Lake

The previous estimate of the Moose Lake herd in 1991 was 300 animals and was not based on a formal population survey, but rather an extrapolated value taken from 211 animals observed during a fall composition survey (Kuzyk & Farnell, 1997). Consequently, the previous value of 300 animals should be interpreted cautiously. As those authors noted, the "*herd could number up to 300 caribou*." The 2017 estimate of 173 animals is the first formal estimate of herd size; its 95% confidence interval includes 211. Evidence from location data indicates that these animals do not stray far from the mountain blocks south and east of Moose Lake (e.g., Plateau Mountain) and a portion of the South Fork Range Mountains northwest of Stokes Lake.

The distribution assessment suggests a resident population of caribou north of the Hess River that display localized movements throughout the year. This group appears to have limited interaction with the Tay River herd and the Redstone herd, and its relationship with the Moose Lake herd remains unclear. The Rogue River in the east, Lansing River in the north, and the Russell Range-Hess River in the south approximately describes this herd's range in the snow-free seasons, with some animals likely using a seasonal north-south corridor into the South Fork Range during winter (**Map 6**, **Map 13**). An apparent shift from the eastern part of the northern range for calving, post-calving and rutting to the hills at the western extent of the northern range has been observed though the reasons for this shift are not well understood (**Map 4**, **Map 6**, **Map 7**, **Map 13**). Although the animals located north of the Hess River, on the Stewart Plateau, exhibit a similar movement ecology to Moose Lake animals (i.e., limited, localized movements), they may not interact substantially, and appear to be relatively isolated from one another (**Map 5, Map 6**); however, sample sizes of collared individuals from these groups are low and limited to females only (APPENDIX 1). For management purposes, the ranges of these two herds have been combined. Based on survey observations of caribou and tracks in the Hess River area, biologists believe there are likely less than 200 animals that make up the Hess River group. This results in a total estimated population in the Moose Lake herd (includes Moose Lake and Hess River groups) to less than 400 animals. Further investigation is warranted to better understand the herd ranges and population dynamics of caribou in the Upper Stewart River.

Insights from Indigenous Knowledge

The desktop distribution assessment provided valuable insights into the seasonal movements and interactions of the Tay River herd with neighbouring herds. The primary winter range, north of Faro, and the mountainous regions west of the North Canol Road occupied from spring to fall, generally align with our past understanding of the herd's distribution. Additionally, the area occupied from spring to fall, centered around Ollie Lakes and west of the North Canol Road (**Map 8**, **Map 9**, **Map 10**, **Map 11**), also aligns with knowledge shared by members of the Nío Nę P'ęnę, Trails of the Mountain Caribou Working Group, who identified this general area, K'á Tə́ (Willow Flats), as a candidate for an Indigenous Protected

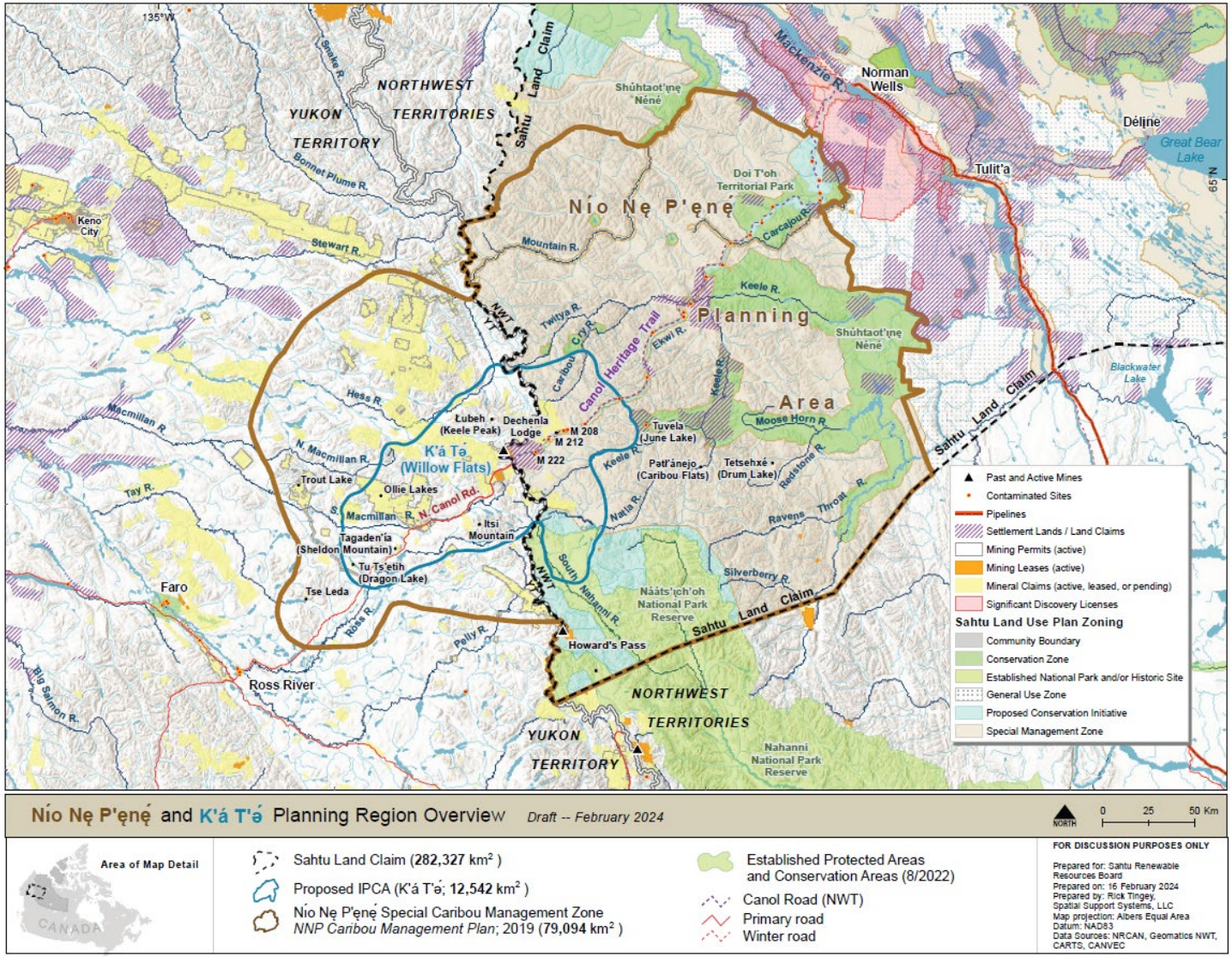
and Conserved Area (IPCA; (Nío Nę P'ęnę Working Group, 2024)). The Nío Nę P'ęnę Working Group (2019) described K'á Tǝ́ (Willow Flats) as:

> "*...a gathering place for five shúhta goʔepeˊ/bedzih/gūdzi̧h [caribou] populations in spring and fall, and those populations are very sensitive to human disturbance. K'á Tǝ́ has been increasingly accessible to visiting harvesters due to advances in All-Terrain Vehicle (ATV) technologies and rapid expansion of trails, causing acute conservation concerns for shúhta goʔepeˊ/bedzih/gūdzi̧h [caribou] and Shúhtaot'ı nę/Métis/Dena ts'ı lı /k'e (ways of life).*"

Location data from 2016 to 2024 demonstrates varied seasonal movement patterns among some individuals, likely influenced by environmental conditions and/or interactions with neighbouring herds. This highlights the challenge of assigning individuals to specific herds or population units, as their movements often transcend the defined boundaries assigned to them. This is particularly evident in the K'á Tǝ́ (Willow Flats) area, where the Nío Nę P'ęnę Working Group (2019) describes five different groups of caribou that occur in the K'á Tǝ́ (Willow Flats) area:

- "*One group of caribou seems to come along the Keele River and go into the Yukon Territory; they come back on the flanks of the Keele Mountain, but over in the Turą́jı Dǝ (Twichya) drainage and west of the Mı hcho Tsíé Dą́ (Caribou Cry River) – they use that Turą́jı Dǝ area in particular and those caribou seem to be doing better than some of the others.*
- *There's another group (likely the "Redstone" herd) that probably comes across a little further south. They come up the Keele in the highland country and the border of the Northwest Territories and Yukon, kind of the flanks of Mac Pass. That group of caribou seems like it's gone or moved off or in decline. We think that it's been about a ten- or fifteen-year gradual decline.*
- *There is also the Finlayson caribou herd that we see here, but there is some concern that they continue on and don't go back to the Finlayson area to winter.*
- *There are caribou that the elders speak of that have a different antler morphology – the antlers are more tightly together and they come in from the Bonnet Plume country.*
- *Then there are caribou that seem to be a little more sedentary that are moving more up and down mountains rather than across large landscapes.*"

This knowledge from the Nío Nę P'ęnę Working Group members demonstrates that our understanding of caribou ecology, often based solely on western science and limited to relatively short timeframes, is narrow and benefits greatly from other ways of knowing.



Map 16. The Nío Nę P'ęnę́ and K'á Tə́ Planning Region, including the K'á Tə́ (Willow Flats) proposed IPCA (Nío Nę P'ęnę Working Group, 2024)**.**

Recommendations and next steps

The difference between the current Tay River herd population estimate (2017) and the old estimate (1991) suggests some caution is needed with respect to management actions. Although the herd appears to have decreased between population estimates, it is difficult to determine if that was the result of a population decline or differences in distribution of the herd and neighbouring herds. Currently, the herd is considered to be stable based on the most recent fall composition values (e.g., calf recruitment) being within the stable range. Portions of the Tay River herd are relatively accessible to harvest via the North Canol Road, and there has been a recent increase in harvest in this area (Game Management Area 9) as of 2023 (**Figure 1**). First Nation subsistence harvest of the herd is unknown so it is not possible to estimate harvest rates accurately. Development in the region has been relatively limited; however, there are several quartz mineral claims that overlap with important caribou areas, including Fireweed Metals Corporation's MacPass Project and Snowline Gold Corporation's Rogue Project and Golden-Oly claims. The seasonal ranges described in this report can help to characterize potential effects to caribou and should be used alongside other forms of knowledge to assess project and cumulative effects to caribou in the region. Given changes in the landscape, both natural and anthropogenic, and concerns about caribou raised by community members, conducting a range assessment to evaluate cumulative effects (Francis, Antoniuk, Nishi, & Kennett, 2013) may be a valuable exercise for the Tay River herd.

It is recommended that continued monitoring work be conducted in the Tay River area given the uncertainty surrounding the 2017 population estimate and our improved understanding of distribution. However, it should be noted that this is a relatively difficult area to monitor caribou, as it is remote and there are several groups or herds that overlap during the fall in this region, making it challenging to accurately estimate population size and trend.

- We recommend fall composition surveys be conducted every other year to monitor trends in adult sex ratios and calf recruitment.
- A new population estimate for the Tay River herd should be conducted within 10 years of the last survey.
- The Moose Lake herd (including the Hess River group) could also be resurveyed during this time.
- We recommend that monitoring priorities, methodologies, and timing be discussed, aligned, and planned collaboratively with partners from the First Nation of Na-Cho Nyäk Dun, Selkirk First Nation and the Kaska Dena to ensure shared goals and approaches are integrated throughout the process.

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APPENDIX 1 SUMMARY OF GPS SATELLITE COLLAR LOCATIONS, 2016–2024

Animal ID	Assigned herd	Date of first location	Date of last location	Total number of locations	Minimum fix interval (hours)	Median fix interval (hours)	Maximum fix interval (hours)
TRCH1601	Tay River	2016-03-02	2018-09-28	870	23.0	23.0	230.0
TRCH1602	Tay River	2016-03-02	2018-10-04	812	2.6	23.0	664.4
TRCH1603	Tay River	2016-03-02	2018-10-27	892	23.0	23.0	207.0
TRCH1604	Tay River	2016-03-02	2018-09-05	833	23.0	23.0	207.0
TRCH1605	Tay River	2016-03-02	2018-08-07	571	16.0	23.0	920.0
TRCH1606	Tay River	2016-03-03	2018-05-01	446	4.7	23.0	2042.3
TRCH1607	Tay River	2016-03-02	2018-08-06	802	23.0	23.0	115.0
TRCH1608	Tay River	2016-03-02	2017-04-24	408	23.0	23.0	69.0
TRCH1609	Tay River	2016-03-02	2018-10-04	857	23.0	23.0	161.0
TRCH1611	Tay River	2016-03-03	2018-10-24	694	12.8	23.0	631.2
TRCH1612	Unassigned	2016-03-03	2018-09-07	547	13.5	23.0	851.0
TRCH1613	Tay River	2016-03-03	2018-08-02	745	10.0	23.0	1507.4
TRCH1614	Tay River	2016-03-03	2018-09-05	826	23.0	23.0	1104.0
TRCH1615	Tay River	2016-03-03	2016-10-13	221	2.6	23.0	69.0
TRCH1616	Tay River	2016-03-03	2016-09-25	179	23.0	23.0	92.0
TRCH1617	Tay River	2016-03-03	2018-08-29	641	15.6	23.0	720.4
TRCH1618	Tay River	2016-03-03	2018-08-12	699	12.9	23.0	746.2
TRCH1619	Tay River	2016-03-03	2018-10-11	808	23.0	23.0	345.0
TRCH1620	Moose Lake	2016-03-04	2018-09-28	812	23.0	23.0	740.1
TRCH1621	Tay River	2016-03-04	2018-01-22	604	23.0	23.0	759.0
TRCH1622	Tay River	2016-03-04	2017-08-12	352	23.0	23.0	276.0
TRCH1623	Tay River	2016-03-05	2017-11-27	548	0.5	23.0	215.8
TRCH1624	Tay River	2016-03-05	2016-06-01	87	23.0	23.0	46.0
TRCH1625	Tay River	2016-03-05	2018-10-22	725	23.0	23.0	230.0
TRCH1626	Tay River	2016-03-05	2018-01-22	339	23.0	23.0	696.3
TRCH1627	Tay River	2016-03-05	2018-07-25	707	23.0	23.0	1817.0
TRCH1628	Tay River	2016-03-05	2016-04-05	28	23.0	23.0	115.0
TRCH1629	Redstone	2016-03-05	2016-08-23	171	23.0	23.0	46.0
TRCH1630	Tay River	2016-03-06	2016-07-24	123	0.5	23.0	115.0
TRCH1631	Tay River	2016-03-12	2016-09-28	97	23.0	46.0	230.0

Animal ID	Assigned herd	Date of first location	Date of last location	Total number of locations	Minimum fix interval (hours)	Median fix interval (hours)	Maximum fix interval (hours)
TRCH1632	Tay River	2016-03-06	2018-07-30	701	0.5	23.0	1409.9
TRCH1633	Tay River	2016-03-06	2018-07-25	748	23.0	23.0	805.0
TRCH1634	Tay River	2016-03-06	2018-07-21	388	14.9	23.0	2329.0
TRCH1635	Redstone	2016-03-06	2018-09-25	861	12.9	23.0	723.1
TRCH1636	Tay River	2016-03-07	2017-08-26	465	23.0	23.0	161.0
TRCH1637	Tay River	2016-03-07	2016-09-07	169	23.0	23.0	69.0
TRCH1701	Moose Lake	2017-02-23	2018-06-21	163	23.0	23.0	2818.6
TRCH1702	Tay River	2017-02-22	2018-11-27	527	23.0	23.0	184.0
TRCH1703	Tay River	2017-02-22	2018-01-06	269	23.0	23.0	644.0
TRCH2001	Redstone	2020-10-05	2021-07-18	1144	5.9	6.0	29.9
TRCH2002	Redstone	2020-10-05	Active	5283	5.9	6.0	29.9
TRCH2003	Hess River	2020-10-09	2023-05-11	3792	0.2	6.0	12.0
TRCH2004	Unassigned	2020-10-09	2022-11-20	3069	0.5	6.0	77.8
TRCH2005	Redstone	2020-10-09	Active	5268	5.9	6.0	12.0
TRCH2006	Redstone	2020-10-10	2021-08-10	1229	0.3	6.0	12.0
TRCH2007	Redstone	2020-10-10	2022-04-29	2278	0.5	6.0	53.9
TRCH2008	Redstone	2020-10-10	2022-04-29	2293	0.1	6.0	29.9
TRCH2009	Redstone	2020-10-10	Active	5262	5.9	6.0	29.9
TRCH2010	Hess River	2020-10-12	2023-04-14	3659	5.9	6.0	12.0
TRCH2011	Hess River	2020-10-12	2023-04-29	3730	0.5	6.0	12.0
TRCH2012	Redstone	2020-10-13	2022-10-31	2998	5.9	6.0	29.9
TRCH2013	Redstone	2020-10-13	2022-05-05	2278	5.9	6.0	29.9
TRCH2014	Redstone	2020-10-13	Active	5246	5.9	6.0	29.9
TRCH2015	Redstone	2020-10-13	Active	5251	5.9	6.0	29.9