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Western Arctic Herd Caribou Use of the Proposed Arctic Mine Footprint and Surrounding Area, 2010–2024



Aerial view of the Bornite Mine, which is connected by road to the village of Kobuk, with the proposed Arctic Mine area in the distance, August 2023.

NPS / KYLE JOLY

Western Arctic Herd Caribou Use of the Proposed Arctic Mine Footprint and Surrounding Area, 2010–2024

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Abstract

A mine, known as the Arctic Mine, has been proposed in the Ambler Mining District north of the village of Kobuk, Alaska. A proposed 211-mile-long industrial road (the Ambler Road) would connect the area and the Arctic Mine to the contiguous continental road system. We documented the use of the area around the proposed Arctic Mine and connecting road by GPS-collared, adult female Western Arctic Herd (WAH) caribou (*Rangifer tarandus*) from 2010 to 2024 prior to development to provide baseline data.

The winter season exhibited the greatest use, followed by fall and then spring, for both the percentage of collared caribou with relocations in and movement vectors intersecting the areas around the proposed mine. Use was quite variable by year and season, ranging from 0–81% of the collared caribou using the area around the proposed mine in any given season. The percent of collared caribou using the Southern Area (the proposed road connecting the Kobuk village-Bornite Mine to the proposed Ambler Road) was generally greater than the percent of collared caribou using the Northern Area (the road north of the proposed Ambler Road leading to the proposed mine area). Summer use was negligible, with a single caribou in the area during August 2010 but none in any other year. Proportion of time spent near the proposed mine was also quite variable. Caribou spent the greatest proportion of time near the proposed mine in winter, with averages reaching as high as 100% of this season in one year. Fall had the next greatest proportion of time used with averages reaching 56% of the season near the proposed mine. Spring averages reached 39% of the season near the proposed mine. In some years, the percent of time spent near the proposed mine was <1%.

Caribou migrations are quite variable with use of winter ranges exhibiting the greatest variability. Caribou use of the area around the proposed Arctic Mine reflects this variability. In many years, depending on the buffer size analyzed, no caribou used the area near the proposed mine. However, given that a 35-km buffer around either the proposed mine's Northern Area or Southern Area footprint represents only about 1% of the herd's range, having up to 76–81% of collared caribou in these areas, respectively, reveals that this region can have a high percentage of WAH caribou present in some years, especially during winter.

Acknowledgments

We thank ADFG biologist Alex Hansen for leading capture operations, his continued collaboration that makes our monitoring possible, and permission to use ADFG WAH GPS data. Monitoring a herd that ranges over a vast and remote landscape provides numerous challenges, so we thank all our collaborators that have helped us over time. The Arctic Inventory and Monitoring Network supported caribou monitoring. We thank Eric Wald, Mat Sorum, Alex Hansen, and Ellen Lyons for reviewing drafts that improved this report.

Introduction

Western Arctic Herd (WAH) caribou (*Rangifer tarandus*) are an integral part of the ecological and cultural fabric of northwest Alaska, roaming this entire region and all five northwest National Park units. Conservation of healthy caribou populations is specifically mentioned within the enabling legislation (the Alaska National Interested Lands Conservation Act) for three of these units and is of great importance to subsistence users in all units.

A mine, known as the Arctic Mine, has been proposed in the Ambler Mining District north of the village of Kobuk (Figure 1). Also proposed is a 211-mile industrial road, known as the Ambler Road, which would connect to the contiguous road system via the Dalton Highway and terminate near the village of Ambler and the yet-to-be-developed mines in northwest Alaska. The Ambler Road would connect to the proposed Arctic Mine to the north, as well as to the road that connects to the existing Bornite Mine and the village of Kobuk to the south (Figure 1). As requested by Ambler Metals LLC, the proposed mine's proponent, this report documents use of the area near the proposed Arctic Mine by adult female WAH caribou.

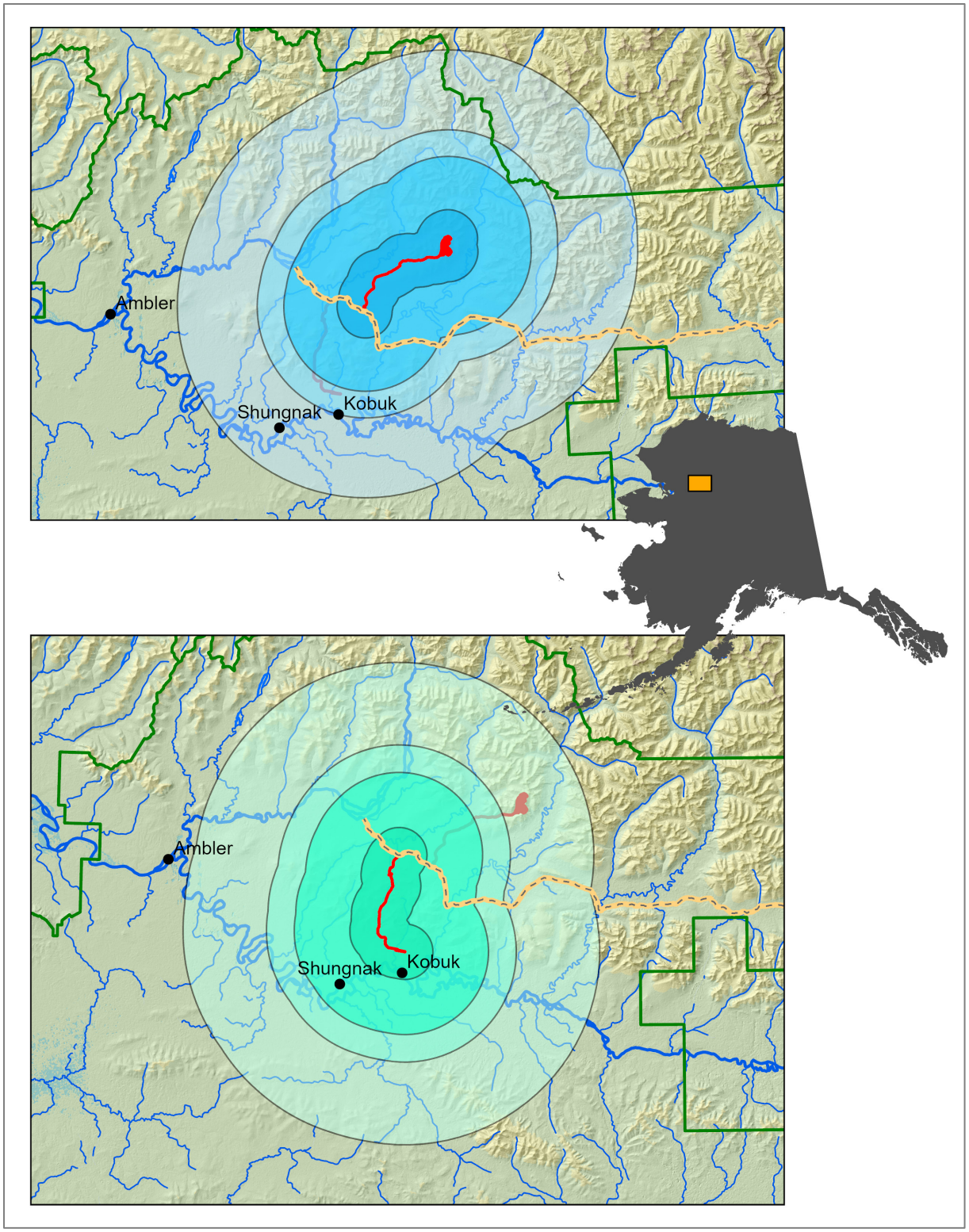


Figure 1. Study area. Northern Area footprint of the proposed Arctic Mine (top) and the Southern Area footprint (bottom), with 5, 15, 20, and 35 km buffers depicted that were used to quantify collar data usage of Western Arctic Herd caribou.

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Methods

The methods outlined here are provided to give the reader a brief summary of the methods and analyses that were conducted to monitor the WAH. Detailed methodologies used to develop this report can be found in Joly et al. (2012).

Collar Deployments

For decades, all WAH collars had been deployed at Onion Portage, Kobuk Valley National Park, from early September to early October. Caribou were captured as they swam across the Kobuk River. As a result of recent late and less robust migration, collars have been deployed using net gun techniques in spring beginning in 2019 and annually since 2021. Both river and net gun captures used protocols approved by State of Alaska and NPS Institutional Animal Care and Use Committees (IACUC). Collars were only deployed on adult (>2 years old) female caribou. Capture operations are led by the Alaska Department of Fish and Game (ADFG), in conjunction and cooperation with the NPS. Every collar is equipped with GPS technology that can transmit position data to satellites that can regularly be downloaded in an office setting. Collars are programmed to collect locations at least every 8 hours throughout the year (i.e., 1,095 relocations per caribou per non-leap year at 8-hour intervals). For collars collecting relocations more frequently than every 8 hours, the data were subsampled to 8 hours for this report to provide consistency among individuals. Data from all the ADFG and NPS collared WAH adult female caribou were used for this report.

Use of Proposed Development Area

ArcPro GIS was used to analyze the caribou GPS data to estimate herd usage of areas around the proposed Arctic Mine development by considering a range of buffer distances. We generated four buffers (5, 15, 20, and 35 km) based on previous studies documenting varying levels of disturbance distances from existing development (Baltensperger and Joly 2019; Boulanger et al. 2012; Plante et al. 2018) around both the Northern and Southern Area footprints (the road connecting the mine to the Ambler Road and the area to be used for the mine itself), which were provided to the NPS by Ambler Metals via ABR, Inc. The Southern footprint was 0.6 km^2, the Northern footprint was 4.0 km^2, and the buffers ranged from 297 to 5,497 km^2. We quantified the number and proportion of collared caribou and their locations within the four buffers for each development using the seasons defined in Joly and Cameron (2024): fall (9/1–11/30), winter (12/1–3/31), spring (4/1–6/15), and summer (6/16–8/31). We also calculated the proportion of time spent by each collared caribou within the four buffers of the north and south development using the location data by season and year, and defined the number of possible locations each season as the number of days multiplied by 3 (possible locations per day). Lastly, we used the tracks from collared caribou (straight line vectors drawn between sequential GPS locations) and quantified the number and proportion of collared caribou that intersected the proposed mine's footprint and each of the four buffers for both the north and south developments by season and year. We considered new deployments as representative of the herd after the first calving season following deployment (Prichard et al. 2023), and we filtered new fall and spring deployments from the analysis accordingly. For movement vector data, we used the date

of the first location to classify season of movement and filtered any vectors greater than 10 days (just one caribou).

Results

Collar Data

The number of GPS collars with a complete year (September–August) of data and total number of GPS locations for that monitoring year are detailed in Table 1 (Joly and Cameron 2024).

Table 1. Collar data. The number (#) of collars with a complete year of data and the total number of GPS locations for that year are reported (Joly and Cameron 2024).

Monitoring Years	# Collars with Complete Year of Data	Total GPS Locations
2023–2024	67	111,540
2022–2023	65	103,094
2021–2022	56	90,619
2020–2021	51	79,517
2019–2020	70	79,161
2018–2019	32	52,044
2017–2018	52	63,277
2016–2017	77	86,651
2015–2016	79	76,284
2014–2015	52	62,076
2013–2014	46	55,971
2012–2013	34	42,965
2011–2012	36	46,706
2010–2011	39	48,892
2009–2010	31	39,086
Total	**787**	**1,037,883**

Use of Proposed Development Area—Proportion of Collared Animals Within Buffer

Northern Area

WAH use of the Northern Area footprint of the proposed Arctic Mine is presented for fall, winter, and spring in Tables 2–4. For the summer season, only one animal (0917) was near the Northern Area footprint in August 2010 and detected in all four buffers. Otherwise, no collared caribou were in any of the four buffers in the summer months of any year.

Table 2. Fall Western Arctic Herd use of the Northern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each fall (Sep 1–Nov 30) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Fall 2023	105	0% (0)	0% (0)	0% (0)	14% (15)
Fall 2022	89	2% (2)	2% (2)	2% (2)	11% (10)
Fall 2021	88	11% (10)	15% (13)	17% (15)	50% (44)
Fall 2020	70	0% (0)	0% (0)	0% (0)	3% (2)
Fall 2019	52	2% (1)	2% (1)	2% (1)	2% (1)
Fall 2018	52	0% (0)	0% (0)	2% (1)	6% (3)
Fall 2017	82	0% (0)	1% (1)	1% (1)	9% (7)
Fall 2016	77	0% (0)	0% (0)	0% (0)	8% (6)
Fall 2015	50	0% (0)	2% (1)	2% (1)	4% (2)
Fall 2014	46	4% (2)	9% (4)	11% (5)	24% (11)
Fall 2013	35	0% (0)	0% (0)	0% (0)	17% (6)
Fall 2012	38	0% (0)	0% (0)	3% (1)	29% (11)
Fall 2011	39	10% (5)	15% (6)	18% (7)	18% (7)
Fall 2010	29	14% (4)	31% (9)	31% (9)	52% (15)

Table 3. Winter Western Arctic Herd use of the Northern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each winter (Dec 1–Mar 31) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Winter 2023–2024	84	0% (0)	0% (0)	0% (0)	11% (9)
Winter 2022–2023	76	3% (2)	3% (2)	3% (2)	8% (6)
Winter 2021–2022	68	18% (12)	25% (17)	29% (20)	76% (52)
Winter 2020–2021	58	0% (0)	0% (0)	0% (0)	3% (2)
Winter 2019–2020	40	3% (1)	3% (1)	3% (1)	8% (3)
Winter 2018–2019	40	3% (1)	3% (1)	3% (1)	10% (4)
Winter 2017–2018	63	2% (1)	2% (1)	2% (1)	2% (1)
Winter 2016–2017	67	0% (0)	0% (0)	0% (0)	3% (2)
Winter 2015–2016	48	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2014–2015	36	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2013–2014	35	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2012–2013	30	0% (0)	0% (0)	0% (0)	3% (1)
Winter 2011–2012	40	3% (1)	3% (1)	3% (1)	3% (1)
Winter 2010–2011	27	0% (0)	0% (0)	7% (2)	11% (3)

Table 4. Spring Western Arctic Herd use of the Northern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each spring (Apr 1–Jun 15) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Spring 2024	84	0% (0)	0% (0)	0% (0)	12% (10)
Spring 2023	76	1% (1)	3% (2)	3% (2)	7% (5)
Spring 2022	73	8% (6)	15% (11)	22% (16)	34% (25)
Spring 2021	57	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2020	41	0% (0)	0% (0)	0% (0)	7% (3)
Spring 2019	41	0% (0)	2% (1)	2% (1)	2% (1)
Spring 2018	62	0% (0)	2% (1)	3% (2)	3% (2)
Spring 2017	66	2% (1)	2% (1)	2% (1)	3% (2)
Spring 2016	46	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2015	33	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2014	35	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2013	30	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2012	29	10% (3)	10% (3)	10% (3)	10% (3)
Spring 2011	28	0% (0)	0% (0)	0% (0)	14% (4)

Southern Area

WAH use of the Southern Area footprint of the proposed Arctic Mine is presented for fall, winter, and spring in Tables 5–7. For the summer season, only one animal (0917) was near the Southern Area footprint in August 2010 and detected in all four buffers. Otherwise, no collared caribou were in any of the four buffers in the summer months of any year.

Table 5. Fall Western Arctic Herd use of the Southern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each fall (Sep 1–Nov 30) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Fall 2023	105	0% (0)	10% (10)	14% (15)	14% (15)
Fall 2022	89	2% (2)	8% (7)	11% (10)	12% (11)
Fall 2021	88	11% (10)	42% (37)	48% (42)	64% (56)
Fall 2020	70	0% (0)	0% (0)	0% (0)	0% (0)
Fall 2019	52	2% (1)	2% (1)	2% (1)	6% (3)
Fall 2018	52	0% (0)	2% (1)	2% (1)	4% (2)
Fall 2017	82	1% (1)	1% (1)	9% (7)	9% (7)
Fall 2016	77	0% (0)	6% (5)	6% (5)	8% (6)
Fall 2015	50	0% (0)	2% (1)	4% (2)	4% (2)

Table 5 (continued). Fall Western Arctic Herd use of the Southern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each fall (Sep 1–Nov 30) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Fall 2014	46	7% (3)	11% (5)	20% (9)	30% (14)
Fall 2013	35	0% (0)	0% (0)	9% (3)	17% (6)
Fall 2012	38	0% (0)	8% (3)	18% (7)	34% (13)
Fall 2011	39	15% (6)	15% (6)	15% (6)	18% (7)
Fall 2010	29	34% (10)	41% (12)	52% (15)	55% (16)

Table 6. Winter Western Arctic Herd use of the Southern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each winter (Dec 1–Mar 31) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Winter 2023–2024	84	0% (0)	5% (4)	8% (7)	11% (9)
Winter 2022–2023	76	1% (1)	8% (6)	8% (6)	8% (6)
Winter 2021–2022	68	15% (10)	71% (48)	74% (50)	81% (55)
Winter 2020–2021	58	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2019–2020	40	3% (1)	8% (3)	8% (3)	20% (8)
Winter 2018–2019	40	3% (1)	10% (4)	10% (4)	13% (5)
Winter 2017–2018	63	0% (0)	2% (1)	2% (1)	2% (1)
Winter 2016–2017	67	0% (0)	3% (2)	3% (2)	3% (2)
Winter 2015–2016	48	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2014–2015	36	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2013–2014	35	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2012–2013	30	0% (0)	3% (1)	3% (1)	3% (1)
Winter 2011–2012	40	0% (0)	0% (0)	0% (0)	3% (1)
Winter 2010–2011	27	0% (0)	4% (1)	7% (2)	15% (4)

Table 7. Spring Western Arctic Herd use of the Southern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each spring (Apr 1–Jun 15) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Spring 2024	84	0% (0)	8% (7)	11% (9)	14% (12)
Spring 2023	76	3% (2)	3% (2)	7% (5)	9% (7)
Spring 2022	73	5% (4)	21% (15)	25% (18)	49% (36)

Table 7 (continued). Spring Western Arctic Herd use of the Southern Area of the Arctic Mine. Shown are the percent (and number) of collared caribou each spring (Apr 1–Jun 15) that were detected within each respective buffer.

Years	Sample Size	% Within 5 km Buffer (n)	% Within 15 km Buffer (n)	% Within 20 km Buffer (n)	% Within 35 km Buffer (n)
Spring 2021	57	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2020	41	0% (0)	2% (1)	5% (2)	12% (5)
Spring 2019	41	0% (0)	0% (0)	2% (1)	2% (1)
Spring 2018	62	2% (1)	2% (1)	2% (1)	2% (1)
Spring 2017	66	0% (0)	3% (2)	3% (2)	3% (2)
Spring 2016	46	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2015	33	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2014	35	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2013	30	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2012	29	0% (0)	10% (3)	10% (3)	10% (3)
Spring 2011	28	4% (1)	7% (2)	11% (3)	21% (6)

Use of Proposed Development Area—Proportion of Season Within Buffer

Northern Area

WAH proportional use of the Northern Area footprint of the proposed Arctic Mine is presented for fall, winter, and spring in Tables 8–10. For the summer season, only one animal (0917) was near the Northern Area footprint in August 2010 and detected in all four buffers. Proportional use ranged from 1%–20% of the season for this individual, depending on the buffer. Otherwise, no collared caribou were in any of the four buffers in the summer months of any year.

Table 8. Fall Western Arctic Herd proportional use of the Northern Area. Shown are the average proportion of the fall (Sept 1–Nov 30) season that collared, adult female Western Arctic Herd caribou were within buffers of the Northern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Fall 2023	–	–	–	8% (1–21)
Fall 2022	5% (3–7)	31% (30–31)	35% (33–36)	27% (1–49)
Fall 2021	6% (1–15)	21% (1–38)	23% (1–46)	23% (3–74)
Fall 2020	–	–	–	6% (2–10)
Fall 2019	1% (1–1)	20% (20–20)	32% (32–32)	56% (56–56)
Fall 2018	–	–	9% (9–9)	16% (6–24)
Fall 2017	–	26% (26–26)	27% (27–27)	8% (1–45)
Fall 2016	–	–	–	15% (1–38)
Fall 2015	–	3% (3–3)	6% (6–6)	14% (7–21)

Table 8 (continued). Fall Western Arctic Herd proportional use of the Northern Area. Shown are the average proportion of the fall (Sept 1–Nov 30) season that collared, adult female Western Arctic Herd caribou were within buffers of the Northern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Fall 2014	4% (1–7)	6% (2–18)	8% (3–18)	10% (0–30)
Fall 2013	–	–	–	1% (0–2)
Fall 2012	–	–	1% (1–1)	2% (0–7)
Fall 2011	2% (0–6)	9% (2–21)	9% (0–23)	17% (0–39)
Fall 2010	16% (4–27)	20% (0–48)	23% (2–51)	20% (1–58)

Table 9. Winter Western Arctic Herd proportional use of the Northern Area. Shown are the average proportion of the winter (Dec 1–Mar 31) season that collared, adult female Western Arctic Herd caribou were within buffers of the Northern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Winter 2023–2024	–	–	–	20% (1–89)
Winter 2022–2023	21% (4–39)	78% (58–97)	80% (61–100)	34% (5–100)
Winter 2021–2022	14% (1–39)	44% (0–96)	55% (0–100)	36% (1–100)
Winter 2020–2021	–	–	–	4% (2–6)
Winter 2019–2020	20% (20–20)	72% (72–72)	72% (72–72)	68% (25–99)
Winter 2018–2019	7% (7–7)	51% (51–51)	55% (55–55)	42% (13–100)
Winter 2017–2018	6% (6–6)	99% (99–99)	100% (100–100)	100% (100–100)
Winter 2016–2017	–	–	–	10% (9–11)
Winter 2015–2016	–	–	–	–
Winter 2014–2015	–	–	–	–
Winter 2013–2014	–	–	–	–
Winter 2012–2013	–	–	–	80% (80–80)
Winter 2011–2012	13% (13–13)	62% (62–62)	63% (63–63)	75% (75–75)
Winter 2010–2011	–	–	1% (1–1)	4% (1–7)

Table 10. Spring Western Arctic Herd proportional use of the Northern Area. Shown are the average proportion of the spring (Apr 1–June 15) season that collared, adult female Western Arctic Herd caribou were within buffers of the Northern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Spring 2024	–	–	–	6% (0–24)
Spring 2023	0% (0–0)	16% (10–22)	21% (11–30)	16% (1–56)
Spring 2022	1% (0–1)	20% (0–55)	28% (0–58)	39% (0–71)
Spring 2021	–	–	–	–
Spring 2020	–	–	–	17% (2–34)
Spring 2019	–	5% (5–5)	7% (7–7)	15% (15–15)
Spring 2018	–	0% (0–0)	1% (1–1)	13% (6–19)
Spring 2017	1% (1–1)	4% (4–4)	5% (5–5)	7% (2–13)
Spring 2016	–	–	–	–
Spring 2015	–	–	–	–
Spring 2014	–	–	–	–
Spring 2013	–	–	–	–
Spring 2012	2% (0–4)	22% (0–63)	23% (1–64)	24% (2–67)
Spring 2011	–	–	–	9% (0–23)

Southern Area

WAH proportional use of the Southern Area footprint of the proposed Arctic Mine is presented for fall, winter, and spring in Tables 11–13. For the summer season, only one animal (0917) was near the Southern Area footprint in August 2010 and detected in all four buffers. Proportional use ranged from 1%–20% of the season for this individual, depending on the buffer. Otherwise, no collared caribou were in any of the four buffers in the summer months of any year.

Table 11. Fall Western Arctic Herd proportional use of the Southern Area. Shown are the average proportion of the fall (Sept 1–Nov 30) season that collared, adult female Western Arctic Herd caribou were within buffers of the Southern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Fall 2023	–	4% (0–16)	8% (0–19)	17% (1–26)
Fall 2022	2% (2–2)	12% (0–24)	19% (1–38)	30% (6–53)
Fall 2021	3% (1–7)	9% (0–27)	16% (1–43)	25% (1–65)
Fall 2020	–	–	–	–
Fall 2019	4% (4–4)	36% (36–36)	50% (50–50)	20% (1–58)
Fall 2018	–	1% (1–1)	8% (8–8)	13% (10–15)

Table 11 (continued). Fall Western Arctic Herd proportional use of the Southern Area. Shown are the average proportion of the fall (Sept 1–Nov 30) season that collared, adult female Western Arctic Herd caribou were within buffers of the Southern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Fall 2017	2% (2–2)	8% (8–8)	7% (1–38)	10% (2–47)
Fall 2016	–	7% (1–18)	13% (3–29)	22% (5–54)
Fall 2015	–	1% (1–1)	4% (3–4)	6% (4–8)
Fall 2014	4% (1–9)	8% (3–15)	6% (0–18)	7% (1–22)
Fall 2013	–	–	0% (0–1)	3% (2–3)
Fall 2012	–	1% (1–3)	2% (1–4)	4% (2–10)
Fall 2011	1% (0–3)	6% (0–14)	9% (0–25)	16% (1–36)
Fall 2010	2% (0–5)	11% (0–29)	13% (1–41)	20% (1–59)

Table 12. Winter Western Arctic Herd proportional use of the Southern Area. Shown are the average proportion of the winter (Dec 1–Mar 31) season that collared, adult female Western Arctic Herd caribou were within buffers of the Southern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
2023–2024	–	26% (1–61)	23% (0–84)	27% (4–99)
2022–2023	4% (4–4)	9% (1–26)	16% (4–43)	39% (14–99)
2021–2022	3% (0–19)	9% (0–91)	19% (1–95)	37% (1–100)
2020–2021	–	–	–	–
2019–2020	10% (10–10)	31% (12–48)	52% (24–74)	35% (4–93)
2018–2019	6% (6–6)	8% (1–19)	21% (9–46)	66% (52–90)
2017–2018	–	11% (11–11)	17% (17–17)	99% (99–99)
2016–2017	–	5% (5–5)	7% (7–7)	28% (21–34)
2015–2016	–	–	–	–
2014–2015	–	–	–	–
2013–2014	–	–	–	–
2012–2013	–	32% (32–32)	64% (64–64)	85% (85–85)
2011–2012	–	–	–	35% (35–35)
2010–2011	–	0% (0–0)	3% (2–4)	7% (2–15)

Table 13. Spring Western Arctic Herd proportional use of the Southern Area. The average proportion of the spring (Apr 1–June 15) season that collared, adult female Western Arctic Herd caribou were within buffers of the Southern Area of the proposed Arctic Mine. Minimum and maximum values presented in parentheses; animals not detected within buffers omitted for calculations.

Years	Avg % Within 5 km Buffer (min–max)	Avg % Within 15 km Buffer (min–max)	Avg % Within 20 km Buffer (min–max)	Avg % Within 35 km Buffer (min–max)
Spring 2024	–	4% (2–9)	6% (1–25)	12% (6–31)
Spring 2023	0% (0–0)	21% (10–32)	12% (1–40)	15% (3–67)
Spring 2022	1% (0–1)	8% (0–38)	15% (0–64)	28% (0–73)
Spring 2021	–	–	–	–
Spring 2020	–	7% (7–7)	7% (0–14)	9% (3–14)
Spring 2019	–	–	3% (3–3)	9% (9–9)
Spring 2018	1% (1–1)	3% (3–3)	4% (4–4)	7% (7–7)
Spring 2017	–	1% (0–2)	3% (2–4)	23% (11–35)
Spring 2016	–	–	–	–
Spring 2015	–	–	–	–
Spring 2014	–	–	–	–
Spring 2013	–	–	–	–
Spring 2012	–	3% (0–7)	5% (1–12)	21% (2–57)
Spring 2011	0% (0–0)	5% (3–8)	11% (0–21)	17% (1–45)

Use of Proposed Development Area—Proportion of Animals Crossing Buffer

Northern Area

WAH proportion of movements intersecting the Northern Area footprint and buffers of the proposed Arctic Mine is presented for fall, winter, and spring in Tables 14–16. For the summer season, only one animal (0917) was near the Northern Area footprint in August 2010 and detected intersecting all four buffers. Otherwise, no collared caribou were in any of the four buffers in the summer months of any year.

Table 14. Proportion of fall caribou movements intersecting the Northern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Northern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during fall (Sept 1–Nov 30).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Fall 2023	105	0% (0)	0% (0)	0% (0)	1% (1)	14% (15)
Fall 2022	89	2% (2)	2% (2)	2% (2)	2% (2)	11% (10)
Fall 2021	88	11% (10)	11% (10)	15% (13)	17% (15)	50% (44)
Fall 2020	70	0% (0)	0% (0)	0% (0)	0% (0)	3% (2)
Fall 2019	52	0% (0)	2% (1)	2% (1)	2% (1)	2% (1)

Table 14 (continued). Proportion of fall caribou movements intersecting the Northern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Northern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during fall (Sept 1–Nov 30).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Fall 2018	52	0% (0)	0% (0)	0% (0)	2% (1)	6% (3)
Fall 2017	82	0% (0)	0% (0)	1% (1)	1% (1)	9% (7)
Fall 2016	77	0% (0)	0% (0)	0% (0)	0% (0)	8% (6)
Fall 2015	50	0% (0)	2% (1)	2% (1)	2% (1)	4% (2)
Fall 2014	46	0% (0)	4% (2)	9% (4)	11% (5)	24% (11)
Fall 2013	35	0% (0)	0% (0)	0% (0)	0% (0)	17% (6)
Fall 2012	38	0% (0)	0% (0)	0% (0)	3% (1)	29% (11)
Fall 2011	39	3% (1)	10% (4)	18% (7)	18% (7)	18% (7)
Fall 2010	29	14% (4)	14% (4)	34% (10)	34% (10)	55% (16)

Table 15. Proportion of winter caribou movements intersecting the Northern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Northern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during winter (Dec 1–Mar 31).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Winter 2023–2024	84	0% (0)	0% (0)	0% (0)	0% (0)	11% (9)
Winter 2022–2023	76	1% (1)	3% (2)	3% (2)	3% (2)	9% (7)
Winter 2021–2022	68	18% (12)	19% (13)	25% (17)	29% (20)	78% (53)
Winter 2020–2021	58	0% (0)	0% (0)	0% (0)	0% (0)	3% (2)
Winter 2019–2020	40	3% (1)	3% (1)	3% (1)	3% (1)	8% (3)
Winter 2018–2019	40	3% (1)	3% (1)	3% (1)	3% (1)	10% (4)
Winter 2017–2018	63	0% (0)	2% (1)	2% (1)	2% (1)	2% (1)
Winter 2016–2017	67	0% (0)	0% (0)	0% (0)	0% (0)	3% (2)
Winter 2015–2016	48	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2014–2015	36	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2013–2014	35	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2012–2013	30	0% (0)	0% (0)	0% (0)	0% (0)	3% (1)
Winter 2011–2012	40	0% (0)	3% (1)	3% (1)	3% (1)	3% (1)
Winter 2010–2011	27	0% (0)	0% (0)	0% (0)	7% (2)	11% (3)

Table 16. Proportion of spring caribou movements intersecting the Northern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Northern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during spring (Apr 1–June 15).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Spring 2024	84	0% (0)	0% (0)	0% (0)	0% (0)	12% (10)
Spring 2023	76	3% (2)	3% (2)	3% (2)	3% (2)	7% (5)
Spring 2022	73	11% (8)	11% (8)	14% (10)	21% (15)	33% (24)
Spring 2021	57	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2020	41	0% (0)	0% (0)	0% (0)	0% (0)	7% (3)
Spring 2019	41	0% (0)	0% (0)	2% (1)	2% (1)	2% (1)
Spring 2018	62	0% (0)	0% (0)	2% (1)	3% (2)	3% (2)
Spring 2017	66	2% (1)	2% (1)	2% (1)	2% (1)	3% (2)
Spring 2016	46	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2015	33	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2014	35	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2013	30	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2012	29	10% (3)	10% (3)	10% (3)	10% (3)	10% (3)
Spring 2011	28	0% (0)	0% (0)	0% (0)	0% (0)	14% (4)

Southern Area

WAH proportion of movements intersecting the Southern Area footprint and buffers of the proposed Arctic Mine is presented for fall, winter, and spring in Tables 17–19. For the summer season, only one animal (0917) was near the Southern Area footprint in August 2010 and detected intersecting all four buffers. Otherwise, no collared caribou were in any of the four buffers in the summer months of any year.

Table 17. Proportion of fall caribou movements intersecting the Southern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Southern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during fall (Sept 1–Nov 30).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Fall 2023	105	0% (0)	1% (1)	12% (13)	14% (15)	14% (15)
Fall 2022	89	0% (0)	2% (2)	8% (7)	11% (10)	12% (11)
Fall 2021	88	2% (2)	11% (10)	43% (38)	48% (42)	64% (56)
Fall 2020	70	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Fall 2019	52	0% (0)	2% (1)	2% (1)	2% (1)	6% (3)
Fall 2018	52	0% (0)	0% (0)	2% (1)	2% (1)	4% (2)

Table 17 (continued). Proportion of fall caribou movements intersecting the Southern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Southern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during fall (Sept 1–Nov 30).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Fall 2017	82	0% (0)	1% (1)	1% (1)	9% (7)	9% (7)
Fall 2016	77	0% (0)	0% (0)	6% (5)	6% (5)	8% (6)
Fall 2015	50	0% (0)	0% (0)	2% (1)	4% (2)	4% (2)
Fall 2014	46	2% (1)	7% (3)	11% (5)	20% (9)	30% (14)
Fall 2013	35	0% (0)	0% (0)	0% (0)	9% (3)	17% (6)
Fall 2012	38	0% (0)	0% (0)	8% (3)	18% (7)	37% (14)
Fall 2011	39	10% (4)	15% (6)	15% (6)	15% (6)	18% (7)
Fall 2010	29	34% (10)	38% (11)	45% (13)	55% (16)	59% (17)

Table 18. Proportion of winter caribou movements intersecting the Southern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Southern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during winter (Dec 1–Mar 31).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Winter 2023–2024	84	0% (0)	0% (0)	6% (5)	8% (7)	11% (9)
Winter 2022–2023	76	0% (0)	1% (1)	8% (6)	8% (6)	8% (6)
Winter 2021–2022	68	0% (0)	18% (12)	71% (48)	75% (51)	81% (55)
Winter 2020–2021	58	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2019–2020	40	0% (0)	3% (1)	8% (3)	8% (3)	20% (8)
Winter 2018–2019	40	0% (0)	3% (1)	10% (4)	10% (4)	13% (5)
Winter 2017–2018	63	0% (0)	0% (0)	2% (1)	2% (1)	2% (1)
Winter 2016–2017	67	0% (0)	0% (0)	3% (2)	3% (2)	3% (2)
Winter 2015–2016	48	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2014–2015	36	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2013–2014	35	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Winter 2012–2013	30	0% (0)	0% (0)	3% (1)	3% (1)	3% (1)
Winter 2011–2012	40	0% (0)	0% (0)	0% (0)	0% (0)	3% (1)
Winter 2010–2011	27	0% (0)	0% (0)	4% (1)	7% (2)	15% (4)

Table 19. Proportion of spring caribou movements intersecting the Southern Area. Shown are the proportion of collared adult female Western Arctic Herd caribou movement vectors that intersected the Southern Area of the proposed Arctic Mine footprint and buffers (5, 15, 20, and 35 km) during spring (Apr 1–June 15).

Years	Sample Size	% Intersect Proposed Footprint (n)	% Intersect 5 km Buffer (n)	% Intersect 15 km Buffer (n)	% Intersect 20 km Buffer (n)	% Intersect 35 km Buffer (n)
Spring 2024	84	0% (0)	0% (0)	8% (7)	11% (9)	14% (12)
Spring 2023	76	0% (0)	3% (2)	4% (3)	7% (5)	9% (7)
Spring 2022	73	0% (0)	10% (7)	21% (15)	23% (17)	49% (36)
Spring 2021	57	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2020	41	0% (0)	0% (0)	2% (1)	5% (2)	12% (5)
Spring 2019	41	0% (0)	0% (0)	0% (0)	2% (1)	2% (1)
Spring 2018	62	2% (1)	2% (1)	2% (1)	2% (1)	2% (1)
Spring 2017	66	0% (0)	0% (0)	3% (2)	3% (2)	3% (2)
Spring 2016	46	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2015	33	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2014	35	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2013	30	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Spring 2012	29	0% (0)	0% (0)	10% (3)	10% (3)	10% (3)
Spring 2011	28	0% (0)	4% (1)	7% (2)	11% (3)	29% (8)

Discussion

The Ambler Road, a 211-mile-long road which would connect the Dalton Highway and contiguous continental road system to the Ambler Mining District, has been proposed. The proposed Arctic Mine lies to the north of the western extent of the Ambler Road, within the Ambler Mining District. The proposed mine would connect to the Ambler Road via a separate proposed road. This connector road and the area the mine would cover constitute the Northern Area footprint of our study area (Figure 1). A road connecting the proposed Ambler Road to the existing Bornite Mine and eventually the village of Kobuk defined the Southern Area footprint. At the request of Ambler Metals LCC, we summarized WAH caribou annual usage of the proposed mine's northern and southern footprints. To do this, we used existing NPS and ADFG GPS data from collared adult female WAH caribou and buffers of 5, 15, 20, and 35 km surrounding the footprints, from 2010 to 2024, during every season.

Caribou are known for highly variable habitat use seasonally, annually, and at even longer timescales (Joly et al. 2021; Taillon et al. 2012). The results of our analyses align with those previous findings. Depending on the buffer size analyzed, in many years, no caribou utilized the area around the proposed mine. However, in other years, over 80% of all collared female caribou in the herd were in the vicinity of the mine. The 35-km buffers around the proposed mine's Northern Area and Southern Area footprints each represent only about 1% of the WAH's range. Having up to 76–81% of WAH collared caribou in these areas in some years reveals that these areas can be highly used by the herd, especially during winter.

A slightly greater proportion of the collared caribou used the Southern Area than the Northern Area. Use was greatest during winter for both areas, followed by fall, spring, and summer, respectively. Summer use was negligible, with a single caribou entering the region during August 2010. In 2010, the herd was much larger than it is currently and fall migrations took place about 20 days earlier than they did in 2023 (Joly and Cameron 2024).

For caribou that entered the buffers, the amount of the season (summer, fall, winter, spring) that they spent within it was also quite variable, ranging from less than 1% to the entire season. For both the Northern and Southern Areas, the amount of the season caribou spent within buffers was greatest during winter, followed by fall, spring, and summer, respectively.

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