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December 13, 2012

Ms. Robyn McGhee, Environmental Scientist
ConocoPhillips Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99503

Subject: **Data Report for Alpine Pipeline Caribou Surveys, 2012**

Dear Ms. McGhee:

This letter report constitutes our final deliverable for the 2012 project titled "Caribou along the Alpine Pipelines." It summarizes data on caribou distribution in 2012 in a survey area encompassing the Alpine pipeline corridor, extending eastward from the Alpine Project facilities on the central Colville River delta to the processing facilities at Kuparuk CPF-2.

Please contact either Brian or Alex with questions or requests for further information.

Thank you,

Brian E. Lawhead, Alexander K. Prichard, and Joseph H. Welch
Senior Scientists and Research Biologist
ABR, Inc.—Environmental Research & Services

Introduction

The State of Alaska's Right-of-Way Lease/Grant Stipulation 2.6.1 states that the pipeline systems carrying liquids between the Alpine Development Project and the Kuparuk Oilfield "… shall be maintained to avoid significant alteration of caribou and other ungulate movement patterns. The Commissioner may require additional measures to mitigate impacts to ungulate movements."

This report addresses that stipulation by summarizing aerial survey data from 2012 (as well as additional telemetry data from 2007–2012) on caribou distribution and movements in the area crossed by the Alpine pipeline corridor, which comprises three adjacent pipelines sharing the same support structure, between the Colville River delta and Kuparuk Central Processing Facility 2 (CPF-2). The data used in this report were collected in concert with surveys conducted for two other, larger projects for ConocoPhillips Alaska, Inc. (CPAI): the Greater Kuparuk Area (GKA) mammal study (Lawhead and Prichard, *in prep.*) and the Alpine Satellite Development Program (ASDP) caribou monitoring study (Lawhead et al., *in prep.*).

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Study Area

Constructed in the winter of 1998–1999, the Alpine pipelines extend 55 km (34 mi) from the processing facilities at the Alpine CD-1 pad to those at Kuparuk CPF-2. ABR conducted aerial surveys of caribou in the area of the pipeline corridor both before (1992–1998) and after construction (1999–2011) (Lawhead and Prichard 2006b, 2007b, 2008b, 2009b, 2010b, 2011b, 2012b).

The Colville East aerial survey area (Figure 1) encompasses most of the length of the Alpine pipelines between the Colville River delta and Kuparuk CPF-2. The survey area extends from the Beaufort Sea coast inland 48–56 km (30–35 mi) (Lawhead and Prichard 2006a). The area surveyed was expanded slightly following the calving surveys to provide broader coverage for the postcalving survey.

Methods

Two methods—aerial transect surveys and telemetry—have been used to examine caribou distribution and movements in the area of the Alpine pipelines in recent years. Aerial transect surveys provide information on the general distribution and abundance of all caribou in the survey area at specific times and telemetry provides information on the annual movements of individual radio-collared caribou throughout the herd's range.

A fixed-wing airplane (Cessna 206), carrying three observers in addition to the pilot, was used to survey 400-m-wide strip transects that were spaced systematically at intervals of 1.6 km (resulting in 50% sampling coverage) in the Colville East survey area once during the latter part of the calving season (9–10 June; Figure 1). Due to inclement weather, we were unable to survey during the peak of calving in the first week of June. Another survey was flown during the postcalving period (22 June) before insect harassment began, covering 800-m wide survey strips spaced at 3.2-km intervals to maintain 50% sampling coverage (Figure 1), and using two observers plus the pilot. Detailed methods used for transect surveys were described previously (Lawhead and Prichard 2012b). The number of caribou observed within the transect strips was doubled to estimate the actual number present, based on the 50% sampling coverage. During the calving survey in 2012, sightability was poor in the southeastern portion of the Colville East survey area due to patchy snow cover, so the estimated densities in that area were adjusted using a sightability correction factor (SCF) developed previously for calving caribou in the Kuparuk area (Lawhead et al. 1994). The density of all caribou, as well as of calves only, was calculated for the entire survey area and within 2-km distance zones north and south of the Alpine pipelines for the calving and postcalving surveys.

To summarize calving distribution and abundance data from aerial transect surveys in mid-June (June 8–16) over the period of 1993–2012 (except 1994), we used the inverse distance-weighted (IDW) interpolation technique of the *Spatial Analyst* extension of *ArcView* GIS software (Environmental Systems Research Institute, Inc., Redlands, CA) to map caribou densities in 2012 and over all years. This analysis used the SCF-corrected total numbers of all caribou and of calves only, pooled in 3.2 × 0.8-km segments of the transect strips; mean values were calculated for segments over all years. The IDW interpolation technique calculated a density surface using each segment centroid and the distance-weighted values for the 14 nearest centroids (200-m grid cells, power = 1). This analysis produced color maps showing surface models of the density of all caribou (adults, yearlings, and calves) and of all calves observed over the entire survey area, to create an easily understood visual portrayal of the data.

From November 2011 through October 2012, telemetry data were available for some radio-collared caribou in both herds that occur in the vicinity of the study area: the Teshekpuk Herd (TH) and Central Arctic Herd (CAH). The CAH consistently uses the area between Alpine and Kuparuk, whereas the TH typically is distributed west of the Colville River delta (Lawhead et al. 2012).

In July 2008, Alaska Department of Fish and Game (ADFG) biologists outfitted four female CAH caribou with Global Positioning System (GPS) collars purchased by CPAI. Six female caribou were collared in July 2009 (a seventh caribou died soon after collaring) and 12 female caribou were collared in June 2010. All collars were retrieved by 24 April, 2012. Most CAH caribou collared in 2010 were captured near the Prudhoe Bay oilfield, but five animals were captured west of the Kuparuk River. All ten active GPS collars deployed on CAH caribou were retrieved in April 2012, although one died in April shortly before collar retrieval. No telemetry data were available for the CAH after that time.

Twelve female TH caribou were outfitted with GPS collars purchased by CPAI in June 2007 (Table 1) (Lawhead et al. 2008). Twenty-seven female caribou in the TH were outfitted with GPS collars in late June 2008; 20 of those collars were provided by the North Slope Borough (NSB) and seven by CPAI. Six more GPS collars purchased by CPAI were deployed on TH females in late June 2009 and 14 satellite collars purchased by NSB, ADFG, and the Bureau of Land Management (BLM) were deployed on 13 male and one female caribou. In June 2010, four male TH caribou were outfitted with satellite collars and 13 female caribou were outfitted with GPS collars funded by NSB, ADFG and BLM. In June 2011, four TH males and four TH females were outfitted with satellite collars and eight males were outfitted with GPS collars funded by NSB, ADFG and BLM. In June 2012, 7 male caribou were outfitted with satellite collars and 17 female caribou were outfitted with GPS collars.

In all years, the TH collars were deployed in the area around Teshekpuk Lake. In addition, satellite telemetry data were available from the NSB, BLM, and ADFG for 25 TH caribou (20 females and 5 males) that had been outfitted with satellite collars before 2007 and still had functioning transmitters in 2007 (Table 1). Telemetry data from the period before November 2011 are described in previous reports (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a).

Table 1. Number, type, and dates of radio-collars deployed on caribou of the Teshekpuk Herd (TH) and Central Arctic Herd (CAH) between June 2006 and June 2012.

Herd	Collar Type	Funding Source	Deployment Date	Retrieval Date	Male	Female	Total[a]
TH	Satellite	NSB, BLM, ADFG	Before 2007	Various	5	20	25
	GPS	CPAI	June 2007	June 2008	0	12	12
	GPS	CPAI	June 2008	June 2009	0	7	7
	GPS	NSB, BLM, ADFG	June 2008	Various	0	20	20
	GPS	CPAI	June 2009	June 2011	0	6	6
	Satellite	NSB, BLM, ADFG	June 2009	Various	13	1	14
	GPS	NSB, BLM, ADFG	June 2009	June 2011	0	16	16
	Satellite	NSB, BLM, ADFG	June 2010	–	4	0	4
	GPS	NSB, BLM, ADFG	June 2010	Various	0	12	12
	Satellite	NSB, BLM, ADFG	June 2011	–	4	4	8
	GPS	NSB, BLM, ADFG	June 2011	June 2013	0	9	9
	Satellite	NSB, BLM, ADFG	June 2012	–	7	0	7
	GPS	NSB, BLM, ADFG	June 2012	Various	0	17	17
CAH	Satellite	NSB, BLM, ADFG	July 2006	June 2009	0	1	1
	GPS	CPAI	June 2008	July 2009	0	4	4
	GPS	CPAI	July 2009	June 2011	0	6	6
	GPS	CPAI	June 2010	April 2012	0	12	12

[a] Some individuals were outfitted sequentially with more than one collar over a period of years.

A complete data set for GPS collars that still are active is not yet available (those data must be downloaded from the collars after retrieval). A partial data set from satellite uplinks was available for this analysis, however. The GPS collars typically obtain five or six successive locations every two days.

Results

Transect Surveys

Calving Survey

During the 2012 calving survey, the highest densities of caribou in the Greater Kuparuk Area occurred south of the Alpine pipelines in the Colville East calving survey area (Figure 2). The highest calving density in 2012 generally occurred farther west than the high-density distribution of calving activity observed in most other years since 1993 (Lawhead and Prichard 2012b). This westward shift in calving distribution has become more common in other recent years (2007, 2009–2011), however.

Within the Colville East calving survey area, a total of 1,014 caribou were observed on transects (Table 2); after adjusting for the 50% sampling coverage and the low sightability in the southeastern portion of the survey area, we estimated that 2,412 caribou were present in the survey area on June 10. In Colville East, the greatest density of calving activity typically occurs in the inland portion of the area, south and southeast of the Alpine pipelines (Lawhead and Prichard 2006b, 2007b, 2008b, 2009b, 2010b, 2011b, 2012b). For example, 11% of caribou groups and total caribou in the Colville East area were found north of the Alpine pipelines during the calving survey in 2012, although that area constitutes about 35% of the survey area. This inland/coastal gradient is reflected in the estimated density data (Table 2), which showed greater numbers and densities south of the Alpine pipelines during the 2012 calving survey, as in 2005–2010. Densities were low near the Meltwater road, however, similar to other recent years (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a).

Postcalving Survey

On June 22, 2,373 caribou were observed in the expanded Colville East survey area (Table 2), resulting in an estimate of 4,749 caribou after adjusting for the 50% sampling coverage. Compared with the calving survey, caribou were more numerous and were distributed farther north, suggesting that mosquitoes had begun to affect their distribution. The portion of the survey area north of the Alpine pipelines contained 72% of the groups and 80% of the individuals observed (Table 2, Figure 3).

Northward movement of CAH caribou typically occurs by late June as mosquitoes emerge in inland areas and begin to harass caribou there, forcing them northward to relief habitat near the Beaufort Sea coast. Average index values of mosquito activity in the second half of June 2012 were above the 30-year average (Lawhead and Prichard, *in prep.*) ABR biologists conducting ground surveys for birds near the coast reported that midges (which typically become active a few days before mosquitoes) had emerged by June 18 and some mosquitoes had emerged by June 21, which is the likely reason that most of the caribou seen on the postcalving survey were located north of the Alpine pipelines. Cool and windy conditions prevailed after June 22, however, and mosquito harassment was low for the rest of June in 2012.

Table 2. Number of groups and caribou observed, and caribou density estimated, north and south of the Alpine pipelines during calving and postcalving surveys in the Colville East survey area, 2012.

Survey	Location	Area Surveyed (km²)[a]	No. of Groups Observed	Total No. of Caribou Observed	No. of Calves Observed	Total Density (no./km²)	Calf Density (no./km²)
Calving	North	248	29	113	33	0.46	0.13
(June 10)	South[b]	470	225	901	256	2.33	0.45
	Total[b]	718	254	1,014	289	1.68	0.48
Postcalving	North	254	38	1,895	507	7.46	2.00
(June 22)	South	594	15	478	109	0.80	0.18
	Total	848	53	2,373	616	2.80	0.73

[a] Sampling coverage was ~50% of the survey area.
[b] Sightability was low in the southeastern portion of the survey area due to patchy snow cover, so densities in that section were multiplied by the SCF (1.88; see text).

Movements of Collared Caribou

GPS Collars (CAH), November 2011–April 2012

The movements of these collared caribou through October 2011 were described previously (Lawhead and Prichard 2012a). In June 2010, ADFG biologists outfitted 12 female CAH caribou with GPS collars purchased by CPAI. One of those animals died in mid-July 2010 and another died in September 2010. A third animal evidently was killed by wolves shortly before collar retrieval in April 2012. The remaining 9 caribou had functioning collars until they were removed in late April 2012. Of the 10 collars that were active between November 2011 and April 2012, none entered the Colville East survey area.

GPS Collars (TH), November 2011–October 2012

Location data for 34 female TH caribou outfitted with GPS collars were available for the period from November 2011 through October 2012. Of those 34 animals, only 2 crossed the Colville River and entered the Colville East survey area (Figure 5).

Caribou 0605 was located southwest of the Alpine pipelines during the calving season in 2012. She moved down the Itkillik River and then northeast, crossing the Alpine pipelines on June 22 just east of the Colville River crossing, and moved rapidly farther downstream. She remained north of the Alpine pipelines and Spine Road for the rest of June and early July. By July 9, she had crossed the Spine Road to the south was located near CPF-1 before moving back north and then along the coast to the east of Prudhoe Bay by July 14. She moved back west of the oilfields, remaining north of the Spine Road. On August 7, she crossed the Alpine pipelines from north to south and continued to the southwest, crossing the Colville River and remaining southwest of Nuiqsut for the rest of the period.

Caribou 0406 crossed the Alpine pipelines from south to north and then recrossed to the south on June 4. She crossed the Meltwater (DS-2P) road from west to east on June 14. She continued eastward and was located east of Prudhoe Bay in early July before returning to the west. On July 9, she crossed the eastern end of the Alpine pipelines from south to north. She moved east and then inland by the end of the period.

Satellite Collars (TH), November 2011–October 2012

Seventeen different TH caribou (13 males and 4 females) had functioning satellite (PTT) collars during this period. None of the collared caribou appeared to cross the Alpine pipelines, but caribou 0812 was recorded on both the south and north sides of the Alpine pipelines in June and July (Figure 5), indicating that she crossed other pipelines during the summer. Caribou 0812 was located with CAH animals ~100 km south of the Alpine pipelines during the 2012 calving season. She moved northward and along the east side of the Meltwater road during June 19–21 and was located south of the Spine Road and east of CPF-1 on June 23. She moved east of the Sagavanirktok River in late June and early July before crossing back to the west of that river on July 20. She was located near Oliktok Point on July 23 and north of the Alpine pipelines on July 25. She continued west near the coast onto the outer Colville River delta (near CD-3) by July 29, then moved west into NPRA with other TH animals. Although she did not appear to have crossed the Alpine pipelines during that period, the satellite collar data had large temporal gaps (approximately 42 h) between successive data uplinks, so it is possible that a crossing event could have been missed.

Discussion and Conclusions

The combined results of aerial transect surveys and radio telemetry provided both indirect and direct evidence, respectively, of crossings of the Alpine pipelines by caribou in 2012. During the calving survey, caribou were distributed on both sides of the pipeline corridor and caribou density was higher north of the Alpine pipelines (Figure 4), suggesting successful crossings. The general pattern of caribou distribution during the 2012 calving season (Figure 2) is consistent with reports of reduced densities of calving caribou within 2–4 km of roads and other infrastructure with human activity (Dau and Cameron 1986, Lawhead 1988, Cameron et al. 1992, Cronin et al. 1994, Lawhead et al. 2004), although consistent displacement from areas near infrastructure without human activity, such as the Alpine pipelines, has not been documented. Although the density of caribou within 2 km of the Alpine pipelines during calving in 2012 was lower than in some other distance zones to the north and south (Figure 4), it was similar to caribou density in the area 6 km and farther south. The area along the Alpine pipelines did not support high-density calving activity in the years before construction of the pipelines (Lawhead and Johnson 2000).

During the 2012 postcalving survey, caribou density was highly variable among distance zones (Figure 4) and most caribou were distributed north of the Alpine pipelines (Figure 3), probably in response to insect harassment. Observers noted that 19% of the caribou groups seen on the survey numbered at least 50 animals and were moving toward the coast, indicating reaction to mosquito activity. During those movements, caribou did not appear to be avoiding or impeded by the Alpine pipelines.

GPS telemetry has demonstrated previously that collared CAH caribou cross the Alpine pipelines frequently (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a). Northward crossings have occurred in May and June as caribou move toward the coast during the calving and postcalving periods, especially after the onset of mosquito harassment. Most crossings have occurred during the insect season between late June and early August, when highly dynamic movements occur in response to changing weather conditions and the resulting levels of insect activity (Curatolo and Murphy 1986, Cronin et al. 1994, Murphy and Lawhead 2000). The movements of caribou during the insect season are predictable in terms of general responses to the waxing and waning of insect harassment, but movements through specific areas are determined by complex interactions that are affected by the previous locations of the caribou; air temperature, wind speed, and wind direction; solar radiation and cloud cover; and the seasonal chronology of insect emergence and life spans. CAH caribou typically move to the coast, and occasionally onto the Colville delta, when mosquito harassment occurs in late June and July, then

move inland again to preferred foraging areas when mosquito harassment abates due to cooler temperatures or higher winds. A prominent issue in oil and gas development has been the extent to which these north/south movements in response to changing weather and insect activity are affected by the presence of development infrastructure and associated activities (Murphy and Lawhead 2000). GPS-collar data for the CAH demonstrated that caribou frequently crossed the Alpine pipelines during the insect season, often crossing and recrossing on the same day or successive days and suggesting that the Alpine pipelines were not impeding caribou movements (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a). Since 2004, CAH caribou have moved as far east as the Alaska/Yukon border during the insect season (Lenart 2009, Lawhead et al. 2011, Lawhead et al. 2012), so they have had less contact with the Alpine pipelines in that season than in previous years. In July 2011, however, some large groups of CAH caribou moved into the area between the Kuparuk field and the Colville delta.

In 2012, very few telemetry data from CAH caribou were available to evaluate summer movement patterns. Data from several collared TH caribou that were apparently moving with the CAH suggests that at least some CAH caribou remained near the Kuparuk oilfield in summer 2012.

In 2004–2012, most movements by collared CAH caribou, which have experience negotiating oilfield infrastructure and thus are more likely to be habituated than are TH caribou, did not suggest delays in crossing (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a). The limited data from TH animals, which have less exposure to and experience negotiating oilfield infrastructure, suggest that they generally were able to cross the Alpine pipelines successfully. It must be borne in mind, however, that telemetry data are suggestive rather than conclusive in interpreting pipeline-crossing behavior, because no one witnessed the encounters and because other factors potentially affecting pipeline crossings (such as snow cover, weather conditions, insect activity, intraspecific behavioral interactions) were not documented. It is possible that telemetry locations spaced 2 h to 2 days apart could obscure delays or aborted crossings, but the multiple documented crossings and analysis of movement rates (ABR, Inc., unpublished data) indicate that caribou that approached the Alpine pipelines were able to cross with little or no delay.

On the basis of the available data, therefore, we concluded that the Alpine pipelines were not significantly altering caribou movements during periods for which survey data were available (spring and early summer) and that no additional mitigation is necessary beyond the elevated design of the pipelines (minimum height 1.5 m [5 ft] above ground level). This conclusion is consistent with previous research, which found that pipelines elevated to a minimum height of 1.5 m (5 ft) were high enough to allow caribou crossings during snow-free periods (Curatolo and Murphy 1986, Cronin et al. 1994, Lawhead et al. 2006).

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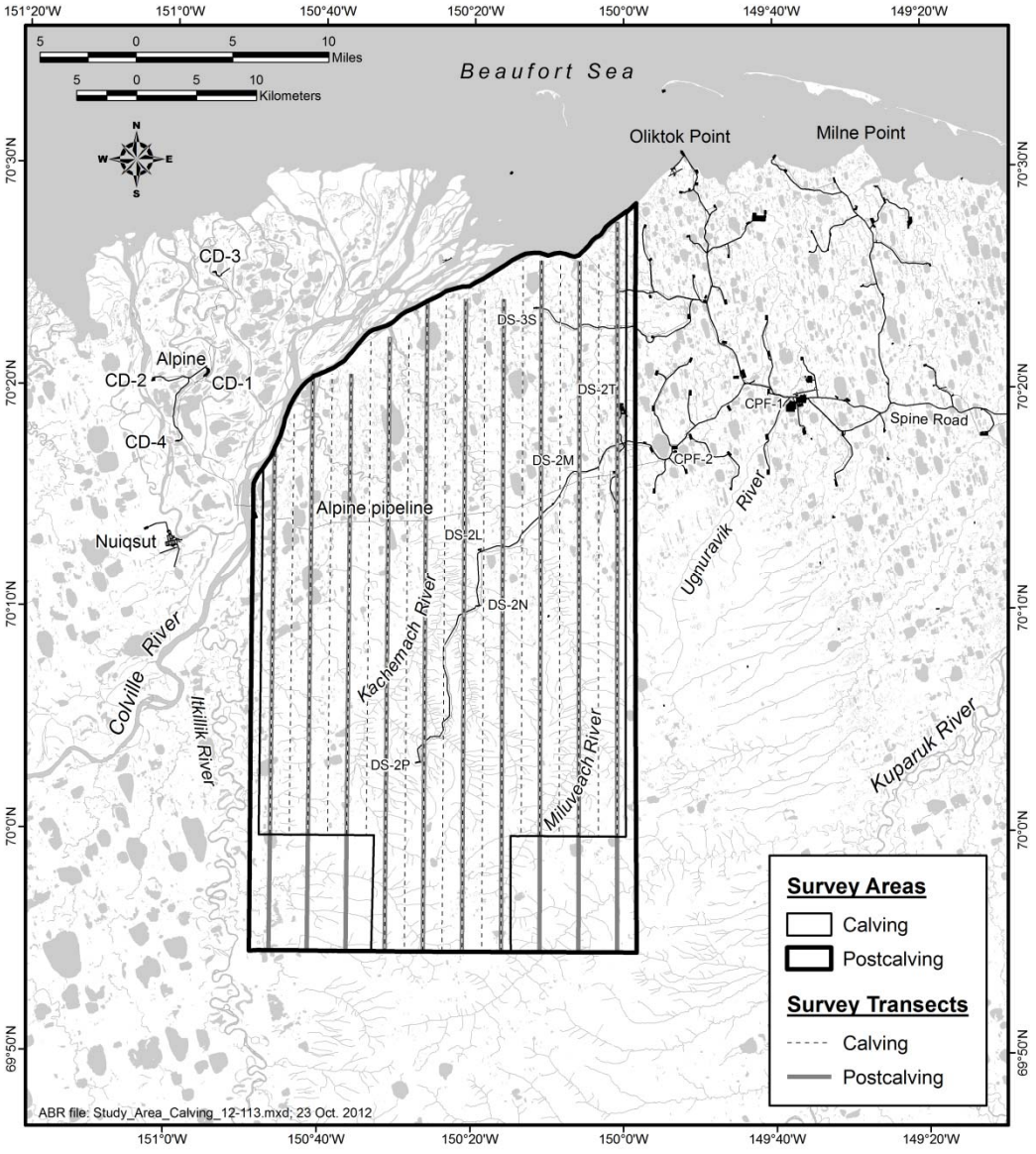

Figure 1. Colville East survey area for systematic aerial strip-transect surveys of caribou, June 2012.

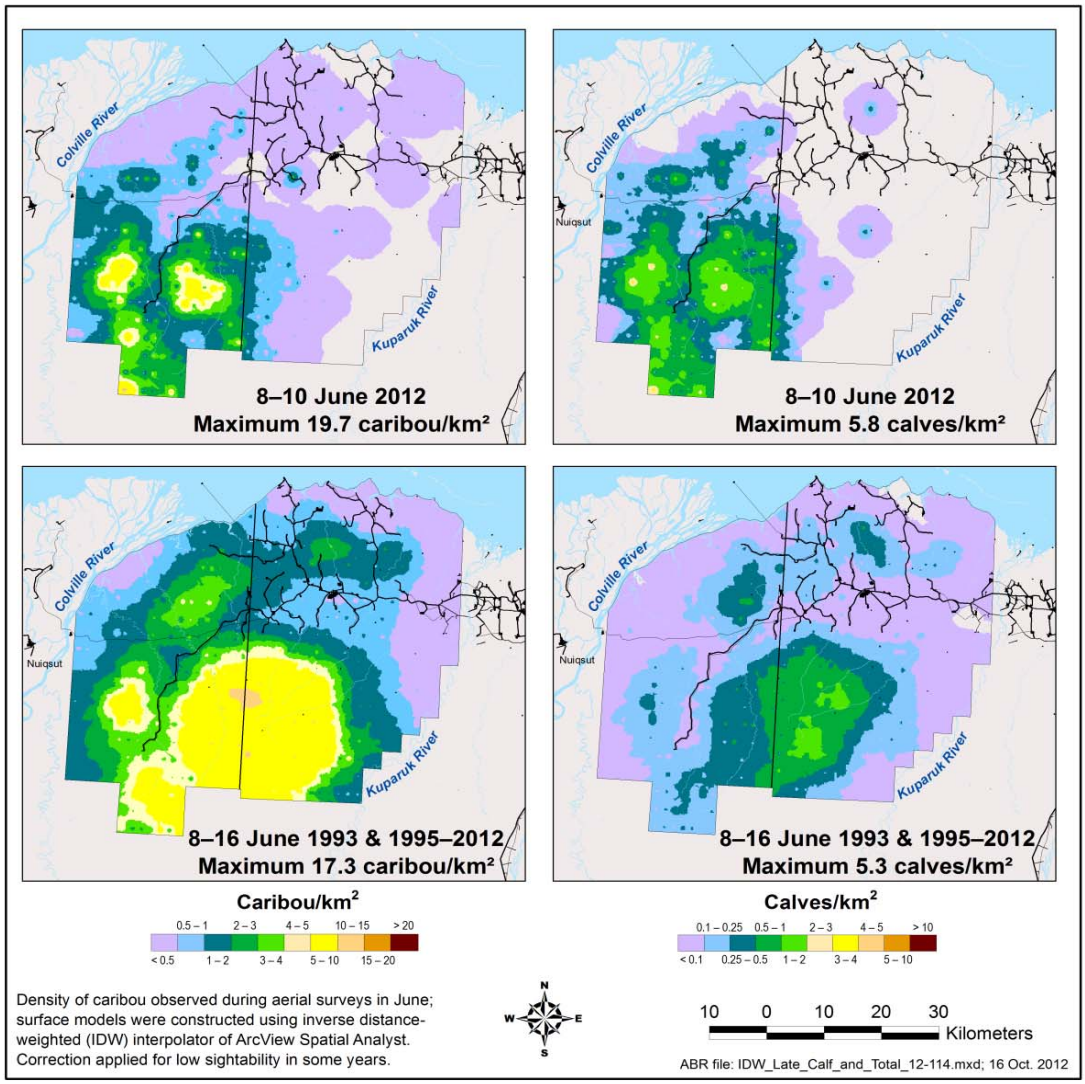

Figure 2. Distribution and density of all caribou and calves in the Kuparuk–Colville calving survey areas during 8–10 June 2012 (top) and distribution and mean density of all caribou during mid-June in the Kuparuk–Colville calving survey areas, 1993 and 1995–2012 (bottom).

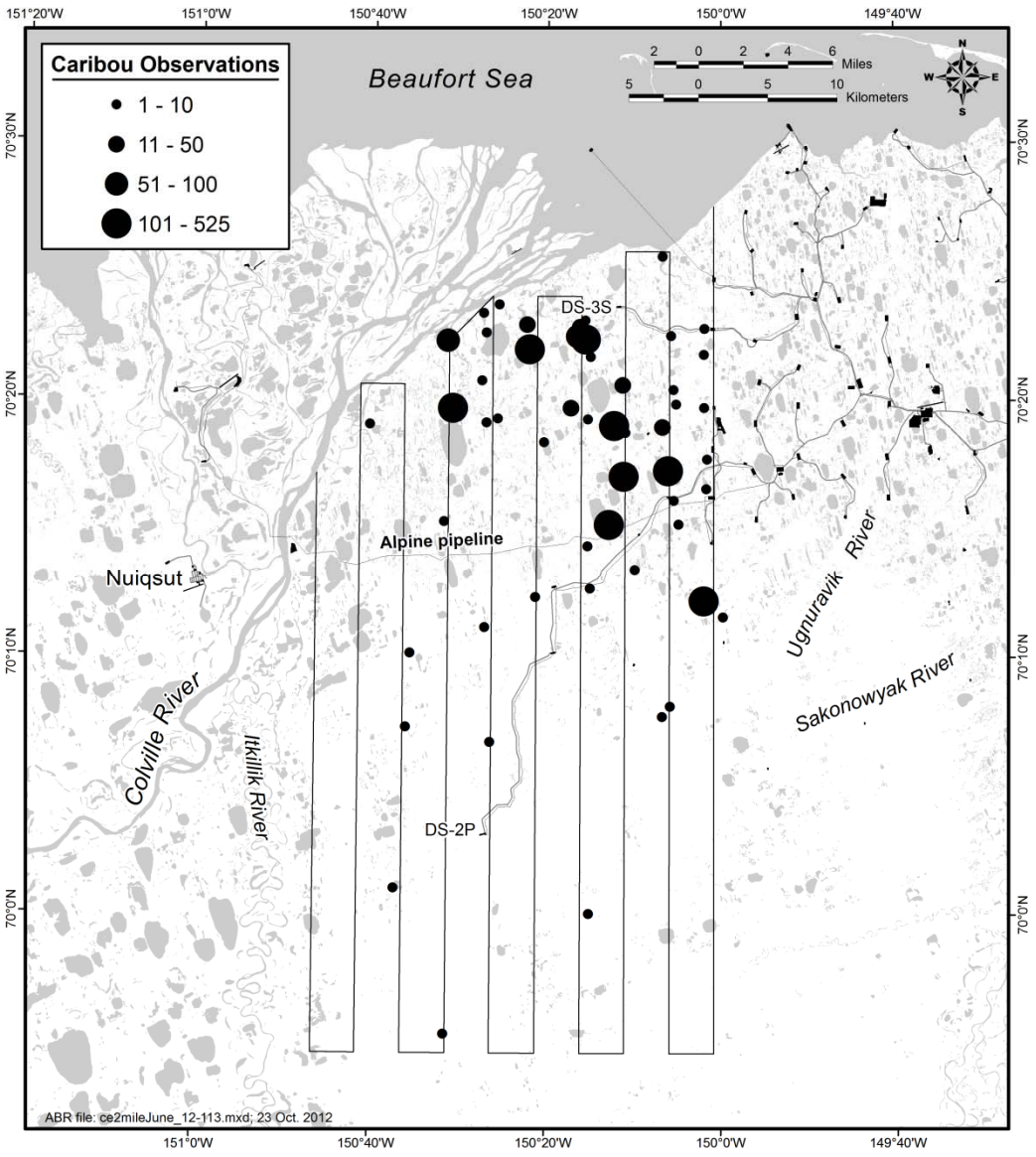

Figure 3. Distribution and size of caribou groups in the Colville East survey area during the postcalving survey on 22 June 2012.

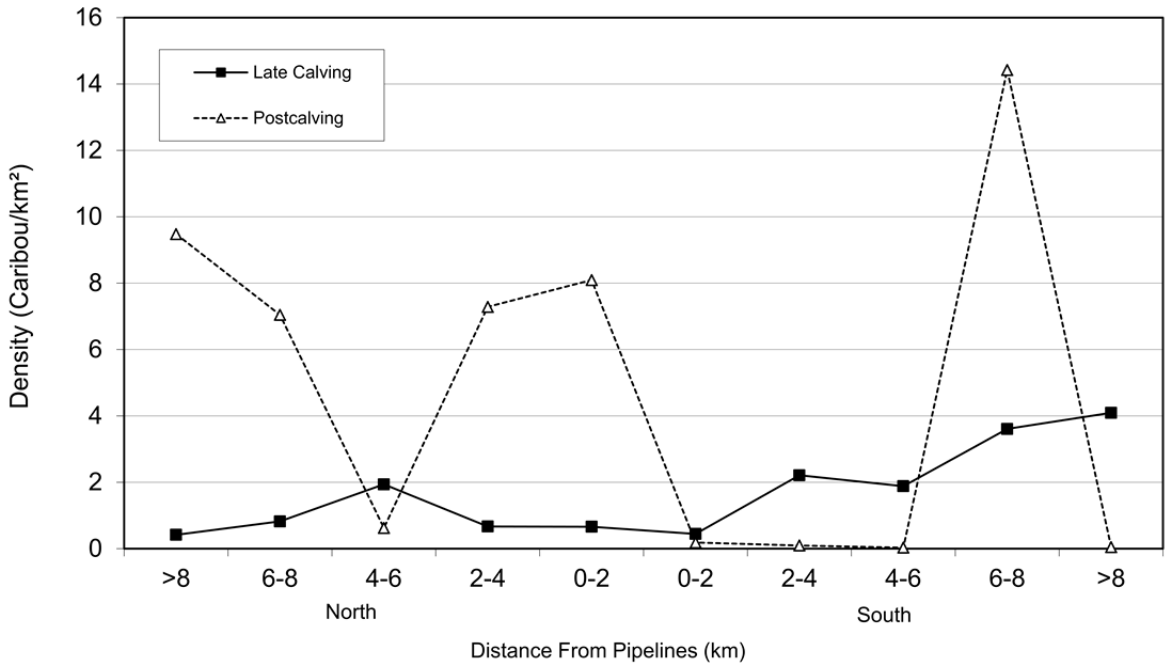

Figure 4. Densities of caribou in different distance zones around the Alpine pipelines during calving and postcalving surveys in the Colville East survey area, June 2012.Caribou numbers in the southeastern portion of the Colville East survey area during the late calving survey in 2012 were multiplied by 1.88 to adjust for low sightability due to patchy snow cover (see text).

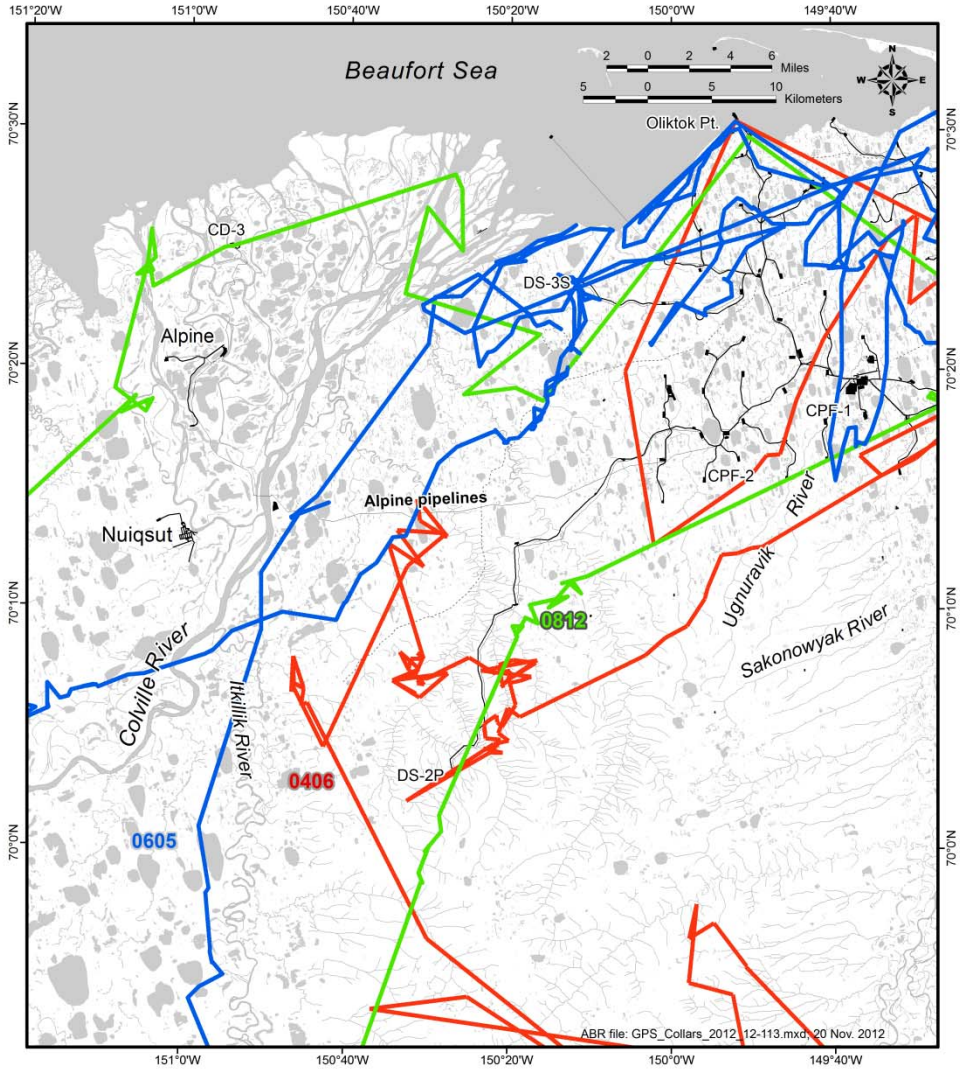

Figure 5. Movements of female TH caribou, equipped with GPS (numbers 0406 and 0605) or satellite collars (number 0812), during November 2011–October 2012 in the area encompassing the Alpine pipelines.