ABR inc.
environmental research & services

7 January 2009

Ms. Sally Rothwell, Environmental Scientist
ConocoPhillips Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99503

Subject: **Data report for Alpine Pipeline caribou surveys, 2008**

Dear Ms. Rothwell:

This letter report constitutes our deliverable for the 2008 project titled "Caribou Along The Alpine Pipelines." It summarizes data on caribou distribution in 2008 in a survey area encompassing the Alpine Pipeline corridor, extending from the Alpine project facilities on the central Colville River delta east to the processing facilities at Kuparuk CPF-2.

Please contact either one of us with questions or requests for further information.

Thank you,

Brian E. Lawhead & Alexander K. Prichard
Senior Scientists
ABR, Inc.

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 data from 2008 (as well as additional telemetry data from 2007) on caribou distribution and movements in the area crossed by the Alpine Pipelines, comprising 3 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 2 larger projects carried out under contract to ConocoPhillips Alaska, Inc. (CPAI): the Greater Kuparuk Area (GKA) mammal study (Lawhead and Prichard 2009) and the Alpine Satellite Development Program (ASDP) caribou monitoring study (Lawhead et al., in prep.).

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 (1999–2008) (Lawhead and Prichard 2007b, 2008b, 2009).

The Colville East aerial survey area (Figure 1) encompasses most of the length of the pipeline corridor between the Colville River delta and the Kuparuk CPF-2 area and 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 have been used in recent years to examine caribou distribution and movements in the area of the Alpine Pipelines. Aerial transect surveys provide information on the general distribution of caribou and radio telemetry provides information on the movements of individual caribou equipped with radio-collars.

A fixed-wing airplane (Cessna 206 or 185) carrying 2–3 observers in addition to the pilot was used to survey systematically spaced strip transects (50% sampling coverage) twice during the calving season in 2008 (2–4 June and 10–11 June, 1.6-km spacing, 400-m strips). The early survey was timed to coincide with the approximate peak of calving in the first week of June and the later survey was near the end of calving. One survey was flown during the postcalving period before insect harassment began (19 June, 3.2-km spacing, 800-m strips). Detailed methods used for transect surveys were described previously (Lawhead and Prichard 2008b). The number of caribou observed within the transect strips was doubled to estimate the actual number present, based on the 50% sampling coverage. Densities of all caribou and of calves were calculated for the entire survey area and for different 2-km distance categories around the Alpine Pipelines for each of the 3 surveys.

To summarize calving distribution and abundance data from aerial transect surveys in early and mid-June (1–8 and 9–16 June) 1993 and 1995–2008, we used the inverse distance-weighted (IDW) interpolation technique of the *Spatial Analyst* extension of *ArcView* GIS software (Environmental Systems Research Institute, Inc. [ESRI], Redlands, CA) to map caribou densities in 2008 and over all years. This analysis used the total numbers of caribou and of calves pooled in each 3.2 × 0.8-km segment 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 (large caribou + calves) and all calves observed over the entire survey area, to create an easily understood visual portrayal of the data.

Telemetry data were available for caribou of the 2 herds that occur in the vicinity of the study area: the Teshekpuk Herd (TCH) and Central Arctic Herd (CAH). The CAH is the herd that consistently uses the area between Alpine and Kuparuk, whereas the TCH typically is distributed west of the study area. In early July 2008, Alaska Department of Fish and Game (ADFG) biologists outfitted 4 female CAH caribou with Global Positioning System (GPS) collars provided by ConocoPhillips Alaska (CPAI); those animals were collared east of the Prudhoe Bay Oilfield.

In 2007–2008, telemetry data for the TCH were obtained from 11 female caribou that were outfitted by ADFG with GPS collars in late June 2007 (Lawhead et al. 2008; those collars were retrieved in late June 2008) and 27 female caribou that were outfitted with GPS collars in late June 2008 (Table 1) (Lawhead et al., in prep.; 20 collars were provided by the North Slope Borough [NSB] and 7 by CPAI). In both years, the TCH collars were deployed in the area around Teshekpuk Lake. In addition, satellite telemetry data from the North Slope Borough (NSB), the U.S. Department of Interior Bureau of Land Management (BLM), and ADFG were available for 26 TCH caribou (21 females and 5 males) that had been outfitted with satellite collars before 2007 and still had functioning collars in 2007 or 2008 (Table 1). One satellite-collared TCH caribou switched to the CAH in early 2007.

Table 1. Number, type, and dates of radio-collars transmitting on caribou of the Teshekpuk Herd (TCH) and Central Arctic Herd (CAH) between September 2007 and September 2008.

Herd	Collar Type	Funding Source	Deployment Date	Retrieval Date	Male	Female	Total [a]
TCH	Satellite	NSB, BLM, ADFG	<2007	Various [b]	5	20	25
	GPS	CPAI	June 2007	June 2008 [c]	0	11	11
	GPS	CPAI	June 2008	–	0	7	7
	GPS	NSB, BLM, ADFG	June 2008	–	0	20	20
CAH	Satellite [d]	NSB, BLM, ADFG	July 2006	–	0	1	1
	GPS	CPAI	June 2008	–	0	4	4

[a] Some individual caribou were outfitted with more than 1 collar over several years.
[b] One died Oct. 2007, 1 died Jan. 2008, 1 died Feb. 2008, 2 died May 2008, 5 retrieved June 2008; 7 active as of Sep. 2008.
[c] One caribou was not captured and the collar remained active in September 2008.
[d] Originally captured with the Teshekpuk Caribou Herd.

Results

Transect Surveys

Systematic surveys of strip transects (Figure 1) provided views of caribou distribution in the survey area at 2 points during the calving period and once in the early postcalving period, before the summer insect-harassment season began. In 2008, the highest densities of calving caribou occurred south of the Alpine Pipelines in the Kuparuk South calving survey area (Figures 2 and 3). The areas of highest densities in 2008 were typical of the high-density distribution of calving activity in most years since 1993 (Lawhead and Prichard 2007b). In the Colville East survey area, the greatest density of calving activity typically occurs inland away from the coast, south and southeast of the Alpine Pipelines (Lawhead and Prichard 2005, 2006b, 2007b, 2008b, 2009). This inland/coastal gradient is reflected by the data on estimated density (Table 2), which showed greater numbers and densities south of the Alpine Pipelines on both calving surveys in June 2008, as in 2005–2007 (Lawhead and Prichard 2006a, 2007a, 2008a). In 2008, a secondary area of relatively high-density calving also occurred north of the Alpine Pipelines and south of DS-3S (Figures 2 and 3). About 35% of the calving survey area was located north of the Alpine Pipelines, where 18% and 13% of the numbers of groups and total caribou, respectively, were found on the first calving survey; the comparable proportions on the second calving survey were 20% and 16%, respectively. The numbers throughout the entire survey area increased substantially between the 2 calving surveys as more calves were born and more caribou moved into the area from the south.

The greatest numbers of caribou among the 3 surveys were found on the second calving survey, when 5,074 caribou were observed on transects (Table 2) and 10,148 were estimated in the Colville East calving survey area. Just over a week later on 19 June, 2,727 caribou were observed (5,454 estimated) in the expanded Colville East survey area (Figure 4). The decrease in caribou numbers between those 2 surveys likely resulted from the movement of some caribou eastward out of the survey area. On 19 June, the portion of the postcalving survey area north of the pipelines (30% of the survey area) contained 30% of the groups and 18% of the individuals seen that day. Large groups of caribou were observed in the southeastern corner of the survey area and an additional 1,900 caribou were seen off-transect nearby (Figure 4).

Northward movement of CAH caribou typically occurs by late June as mosquitoes emerge inland and begin to harass caribou there, forcing them northward to relief habitat near the Beaufort Sea coast. ABR biologists were not present in the field to record the onset of mosquito harassment in 2008, but the widespread distribution of caribou on 19 June suggested that mosquitoes had not yet emerged in numbers throughout the entire survey area; the large groups in the southern portion of the survey area suggest that mosquitoes may have been active inland at that time, however. ABR bird researchers noted moderate to severe mosquito harassment on the Colville River delta on 23–24 June, and several thousand caribou were observed moving eastward near Milne Point on 25 June (C. B. Johnson, pers. comm.). ADFG researchers found some radio-collared CAH caribou at the coast near Milne Point on 23–24 June (E. Lenart, pers. comm.), corroborating the occurrence of widespread mosquito harassment on those dates. CAH caribou subsequently moved farther east and remained well east of the Alpine Pipelines for the remainder of the summer insect season.

Table 2. Number of groups and caribou observed and estimated density of caribou north and south of the Alpine Pipelines during calving and postcalving surveys, Colville East survey area, 2008.

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)
Early Calving	North	248	93	239	31	0.96	0.13
(3–4 June)	South	470	426	1,666	180	3.54	0.38
Late Calving	North	248	131	808	136	3.26	0.55
(11 June)	South	470	510	4,266	783	9.08	1.67
Postcalving	North	254	44	480	119	1.89	0.47
(19 June)	South	594	100	2,247	470	3.78	0.79

[a] Sampling coverage was 50% of the survey area.

Caribou densities were relatively low in all distance zones during the first calving survey and were lower within several kilometers of the Alpine Pipelines during the second calving survey than in areas farther north and south (Figure 5). Examination of caribou distribution during calving (Figures 2 and 3) suggests that the lower densities near the Alpine Pipelines on the latter survey resulted from a localized area of high-density calving activity north of the pipelines and south of DS-3S, similar to that seen in some previous years.

Movements of Collared Caribou

GPS collars (TCH), June 2007–June 2008 — Two of the 11 animals with functioning GPS collars deployed in late June 2007 moved onto the Colville River delta in the last week of July 2007 (Lawhead et al. 2008). One of those (Caribou 0404 [previously 0702 with an earlier collar]) moved onto the delta on 27 July 2007. During 1–6 August 2007, she remained within about 5 km of the Alpine Pipelines between

the CD-4 pad and the western end of the HDD river crossing, crossing the pipelines multiple times before departing the delta to the west on 7 August.

Only 1 of the 11 GPS-collared caribou moved into an area near the Alpine Pipelines during 2008. Caribou 0623 approached the pipelines on 27 May, ~4 km east of the Colville River, after wintering along the upper Kuparuk River. She approached from the southeast to within about 300 m of the pipelines, then turned south and remained south of the Alpine Pipelines and west of the DS-2P (Meltwater) access road until 5 June, when she crossed the Colville River and moved west toward Teshekpuk Lake. Caribou 0621 spent most of the period between mid-December and early April within 10 km of Nuiqsut but did not come near the Alpine Pipelines.

GPS collars (TCH and CAH), June–October 2008 — In late June–early July 2008, 11 female caribou were outfitted with GPS collars provided by CPAI; 4 were placed on CAH caribou and 7 on TCH caribou. In addition, 1 TCH animal (Caribou 0624) collared in 2007 was moving with caribou of the Western Arctic Herd several hundred km away in late June 2008, so its collar could not be recovered. That caribou rejoined the TCH during fall 2008. Only 1 of these collared caribou moved into an area near the Alpine Pipelines in 2008. Caribou C0822 was a CAH animal that moved from the southeast to within about 800 m of the Alpine Pipelines just south of DS-2M on 30 August. She then turned southwest and remained in the vicinity of the Tarn and Meltwater roads until 10 September, when she moved off to the south.

The 20 GPS collars deployed on TCH females for the NSB in June–July 2008 provided only sporadic locations during July–October 2008, but none appeared to cross the Alpine Pipelines, consistent with the more westerly distribution of that herd.

Satellite collars (TCH), 2007–2008 — Because they were not included in the 2007 report (Lawhead and Prichard 2008a) due to delayed receipt of the data, we include the movements of satellite-collared TCH caribou since January 2007 in this report. Satellite-collar locations were obtained for 26 caribou (21 females and 5 males) for part or all of the period 1 January 2007–30 September 2008. Transmitters were functioning on 17 caribou (16 females, 1 male) at the end of 2007 and on 8 female caribou in September 2008 (Table 1); the collars were deployed in 2004–2006. Because satellite transmitters were active only for 6 hours every 2 days during this time period, movement paths have low temporal resolution and the location of caribou between locations is inferred, resulting in uncertain precision.

All crossings of the Alpine Pipelines by these satellite-collared TCH animals occurred in mid-2007; none did so in late 2007 or 2008.

Caribou 0408 moved through the study area in mid-June 2007 while migrating back to the Teshekpuk Lake area. It was near DS-2P (Meltwater) on 11 June and near the northwest corner of the Colville River delta on 14 June. A straight line between those 2 locations passes between Nuiqsut and the Alpine Pipelines.

Caribou 0509 moved from the eastern Colville River delta on 30 July 2007 to south of the Alpine Pipelines and east of the Colville River by 1 August. He then crossed the central portion of the Alpine Pipelines corridor and moved back to the eastern Colville River delta on 3 August.

Caribou 0605 was captured with the TCH in 2006 but joined the CAH in spring 2007. It was located south of the Alpine Pipelines on 20 June 2007, moved north across the central portion of the Alpine Pipelines corridor on 22 June, and crossed south again near DS-2L on 24 June. It then moved back north of the pipelines to the eastern Colville River delta between 2 and 4 July.

Caribou 0606 moved onto the Colville River delta from the west on 26 July 2007. On 3 August it moved along the Colville River from just north of the Alpine Pipelines to just south of them on 5 August, before moving farther west.

Caribou 0607 moved onto the Colville River delta from the west on 28 July 2007. On 30 July it was on the eastern delta and on 1 August was south of the Alpine Pipelines near the Colville River. It then moved out of the area to the southwest.

Caribou 0609 moved onto the Colville River delta on 28 July 2007 and moved east along the coast into the northern Kuparuk Field until 30 July. It was located south of the Alpine Pipelines, about 18 km south of CPF-2, on 1 August, so appeared to have crossed the eastern portion of the Alpine Pipelines.

Caribou 0612 moved onto the Colville River delta from the west on 26 July 2007 and moved to the eastern delta on 30 July. It then moved slowly south along the Colville River. It was just north of the Alpine Pipelines on August 3 and just south of the pipelines and east of Nuiqsut on August 5. It then moved out of the area to the southwest.

Caribou 0615 crossed the Alpine Pipelines from the west to the east between Alpine and Nuiqsut on 28 July 2007. It moved to the eastern Colville Delta on July 30. It was then south of the Alpine Pipelines along the Colville River on August 1. It moved north along the Meltwater Road and across the Alpine Pipelines to the vicinity of CPF-2 on 3 August. On August 5 it was once again south of the Alpine Pipelines near the Tarn Pad.

Discussion and Conclusions

The combined results of aerial transect surveys and telemetry tracking of GPS-collared and satellite-collared caribou provided indirect and direct evidence, respectively, of crossings of the Alpine Pipelines in 2008. Caribou densities were higher south of the Alpine Pipelines during calving and postcalving surveys than north of the pipelines, but caribou were distributed on both sides of the pipelines corridor. During the 2008 postcalving survey, caribou were distributed throughout the survey area, with the largest groups observed in the southeastern survey area and off transect just east of there. The general pattern of caribou distribution during the 2008 calving season supports previous reports of reduced densities of calving caribou within 2–4 km of active 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), but no indication of consistent displacement from areas near infrastructure without human activity, such as the Alpine Pipelines, has been documented.

As the previous movements of GPS-collared caribou have demonstrated, CAH caribou cross the Alpine Pipelines frequently (Lawhead and Prichard 2006a, 2007a). Northward crossings of the pipelines have occurred during May and June as caribou moved toward the coast during the calving and postcalving periods, especially after the onset of mosquito harassment. Most crossings have occurred during the insect season, a highly dynamic period between late June and early August when caribou movements are affected primarily by changing weather conditions and the resulting levels of insect activity (Curatolo and Murphy 1986, 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 involving previous locations of the caribou; air temperature, wind speed, and wind direction; solar radiation; and the seasonal chronology of insect emergence and life spans. CAH caribou typically move to the coast and Colville River 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 whether these north/south movements in response to changing weather and insect activity are limited by the presence of development infrastructure or activity (Murphy and Lawhead 2000).

The GPS-collar data set 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, indicating that the Alpine Pipelines were not impeding caribou movements (Lawhead and Prichard 2006a, 2007a).

In 2004–2006, most movements by collared CAH caribou, which have experience negotiating oilfield infrastructure and thus are more likely to be habituated, did not suggest delays in crossing (Lawhead and Prichard 2006a, 2007a). The limited data from TCH animals, which have less exposure and experience negotiating oilfield infrastructure, suggest that they generally were able to cross the Alpine Pipelines successfully. It must be borne in mind that telemetry data are suggestive rather than conclusive in interpreting pipeline-crossing behavior, however, 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 5 hr to a day 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 (Curatolo and Murphy 1986, Cronin et al. 1994, Lawhead et al. 2006), which found that pipelines raised to a minimum height of 1.5 m (5 ft) were elevated sufficiently to allow caribou crossings during snow-free periods.

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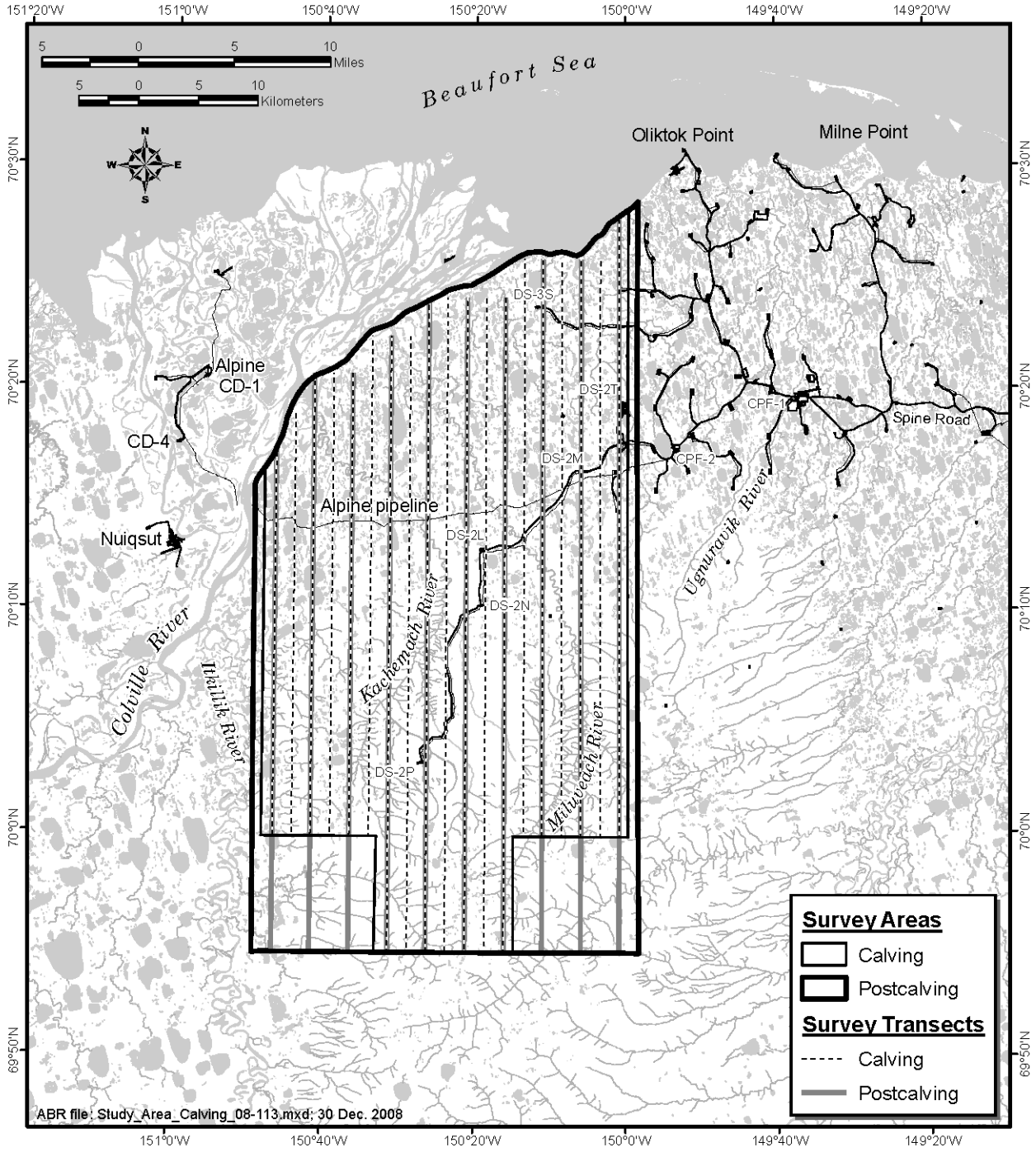

Figure 1. Colville East survey area for systematic aerial strip-transect surveys of caribou, June 2008.

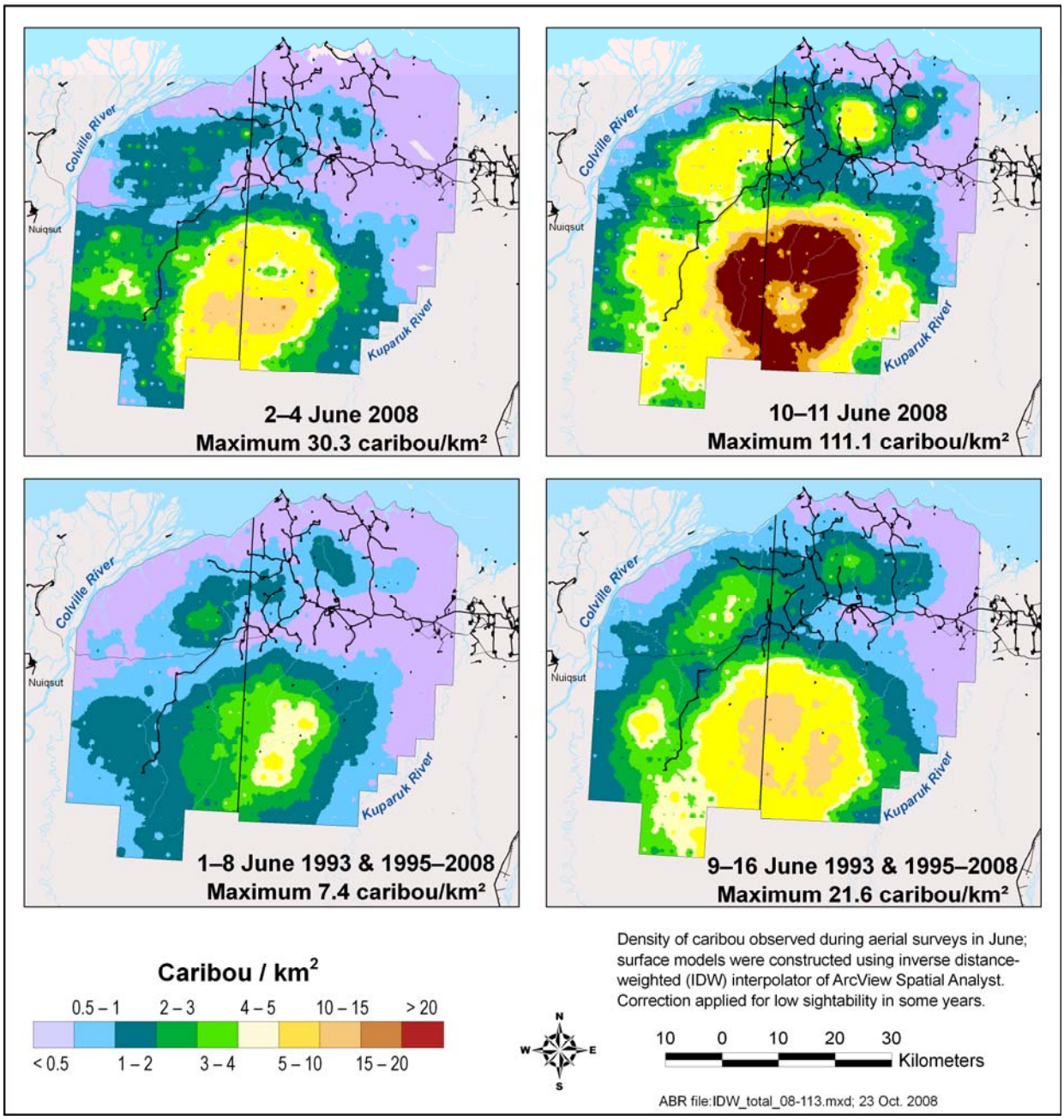

Figure 2. Distribution and density of all caribou in the Kuparuk–Colville calving survey areas during 2–4 June and 10–11 June 2008 (top) and distribution and mean density of all caribou during early June and mid-June in the Kuparuk–Colville calving survey areas, 1993 and 1995–2008 (bottom).

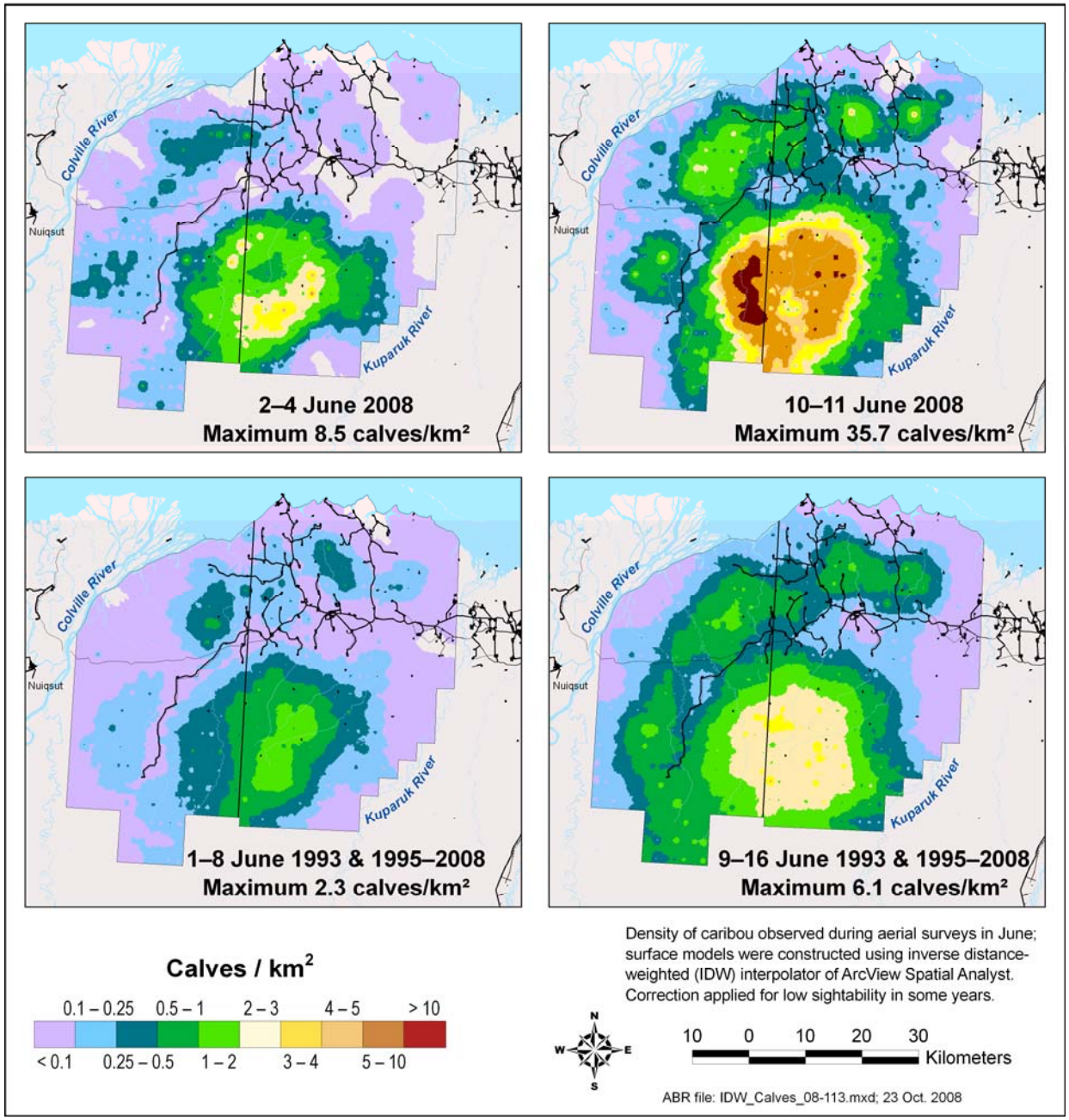

Figure 3. Distribution and density of calf caribou in the Kuparuk–Colville calving survey areas during 2–4 June and 10–11 June 2008 (top) and distribution and mean density of calf caribou during early June and mid-June in the Kuparuk–Colville calving survey areas, 1993 and 1995–2008 (bottom).

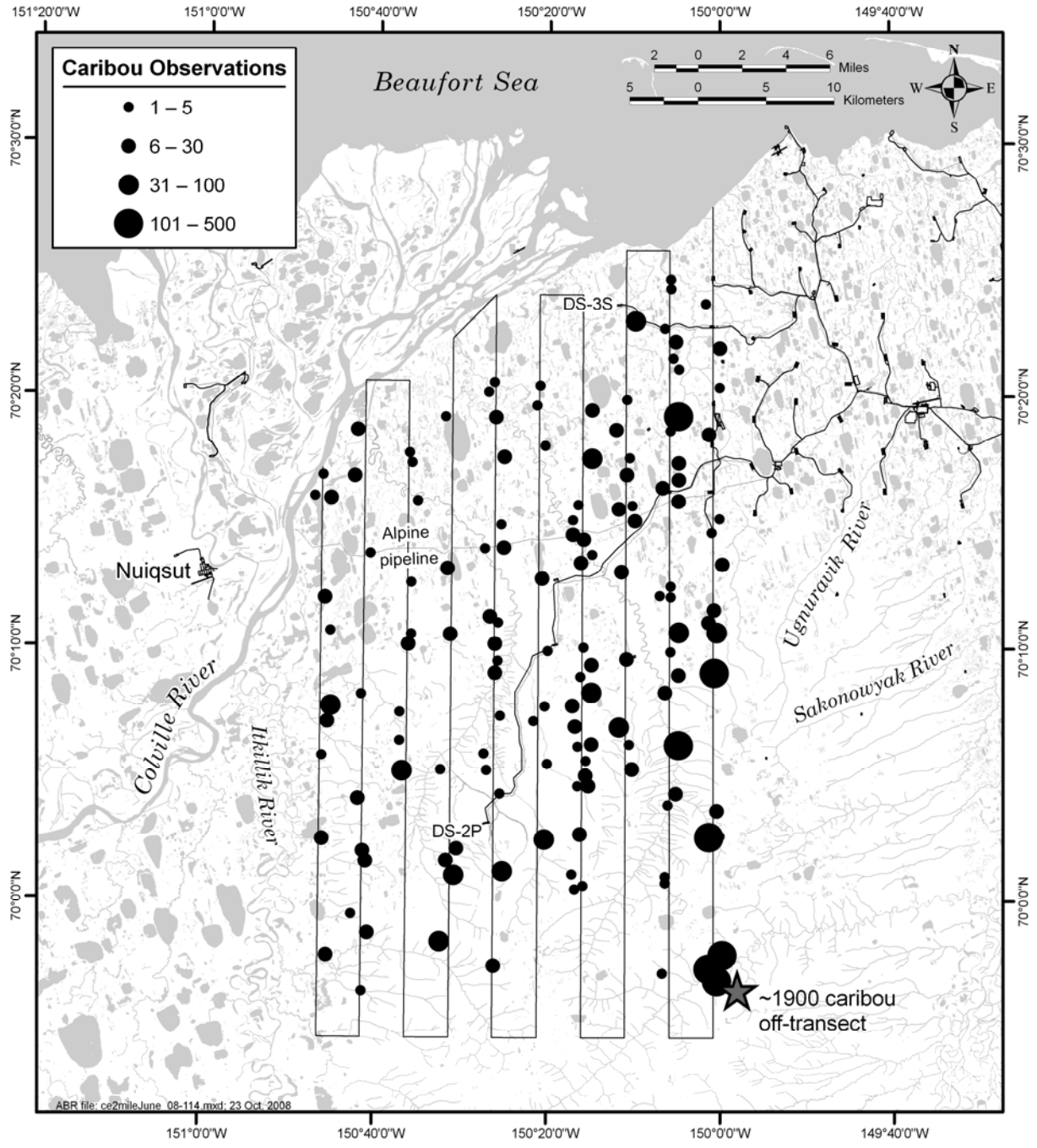

Figure 4. Distribution and sizes of caribou groups in the Colville East survey area during the postcalving survey on 19 June 2008.

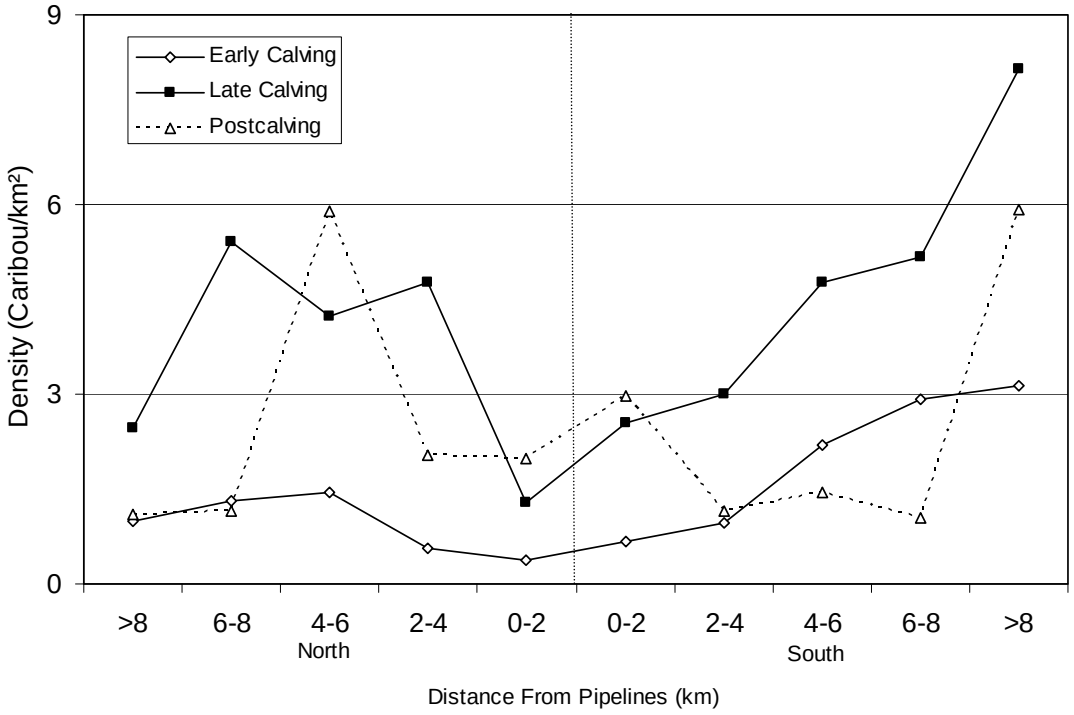

Figure 5. Densities of caribou in different distance zones from the Alpine Pipelines during calving and postcalving surveys in the Colville East survey area, June 2008.