ABR inc.
environmental research & services

28 January 2007

Ms. Caryn Rea, Senior Staff Biologist
ConocoPhillips Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99503

Subject: **Data report for Alpine Pipeline caribou surveys, 2007**

Dear Ms. Rea:

This letter report constitutes our deliverable for the 2007 project titled "Caribou Along The Alpine Pipelines." It summarizes data on caribou distribution in 2007 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 letter report addresses the stipulation by summarizing data from 2007 on caribou distribution and movements in the area crossed by the Alpine Pipelines (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 larger projects carried out under contract to ConocoPhillips Alaska, Inc. (CPAI): the Greater Kuparuk Area (GKA) mammal study (Lawhead and Prichard 2008) and the Alpine Satellite Development Program (ASDP) caribou monitoring study (Lawhead et al. 2008).

## Study Area

The Alpine Pipelines extend ~55 km (34 mi) from the processing facilities at the Alpine CD-1 pad to those at Kuparuk CPF-2. The Colville East aerial survey area 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 Alpine Pipelines were constructed in the winter of 1998–1999. ABR conducted aerial surveys of caribou in the area of the pipeline corridor both before (1992–1998) and after construction (1999–2007) (Lawhead and Prichard 2007b, 2008).

## Methods

Two methods have been used in recent years to examine caribou distribution and movements in the area of the Alpine Pipelines. Aerial surveys provide information on caribou distribution and telemetry provides information on movements by individual radio-collared caribou. In 2007, the available telemetry data came from 12 female caribou of the Teshekpuk Herd (TH) that were outfitted with GPS collars in July 2006 (Lawhead et al. 2007; the collars were retrieved in late June 2007) and 12 female TH caribou that were outfitted with GPS collars in late June 2007 (Lawhead et al., in prep.). GPS collars were deployed on TH caribou by ADFG biologists in the area around Teshekpuk Lake. No 2007 telemetry data were available for the Central Arctic Herd (CAH), which is the herd that primarily uses the area between Alpine and Kuparuk, because ADFG no longer has functioning GPS or satellite collars in that herd.

A fixed-wing airplane (Cessna 206 or 185) carrying two observers in addition to the pilot was used to survey systematically spaced strip transects (50% sampling coverage) twice during the calving season in 2007 (2–5 June and 11–12 June, 1.6-km spacing, 400-m strips) and twice during postcalving (18 and 24 June, 3.2-km spacing, 800-m strips). The early calving survey was timed to coincide with the approximate peak of calving in the first week of June and the later calving survey was near the end of calving. Detailed methods used for transect surveys were described by Lawhead and Prichard (2007b). The number of caribou observed in the survey area 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 1-km distance categories around the Alpine Pipelines for each survey.

To summarize calving distribution and abundance data from early and mid-June (1–8 and 9–16 June) surveys in 1993 and 1995–2007, 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 2007 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.

# Results

## Transect Surveys

Systematic surveys of strip transects provided views of caribou distribution in the survey area at four points during the calving season and the early postcalving period before the summer insect-harassment season began. In 2007, the highest densities of calving caribou occurred south of the Alpine Pipelines in the Colville East calving survey area (Figures 1 and 2). The areas of highest densities in 2007 were farther west than the average high-density distribution of calving caribou in most years since 1993 (Lawhead and Prichard 2007b). A similar westward shift has occurred in several other years recently, most notably 2004 and 2005 (Lawhead and Prichard 2005, 2006b). In the Colville East survey area, the greatest density of calving activity typically occurs inland away from the coast, south of the Alpine Pipelines (Lawhead and Prichard 2006b, 2007b). This inland/coastal gradient is reflected by the data on estimated density (Table 1), which showed greater numbers and densities south of the Alpine Pipelines on both calving surveys in June 2007, as in 2005 and 2006 (Lawhead and Prichard 2006a, 2007a). In 2007, a secondary area of high-density calving also occurred north of the Alpine Pipelines and south of DS-3S (Figures 1 and 2). About 35% of the calving survey area was located north of the Alpine Pipelines and 12% and 13% of the numbers of groups and total caribou, respectively, were found there on the first calving survey; the comparable proportions on the second calving survey were 19% and 16%, respectively. The numbers in both parts of the survey area increased substantially between the two surveys as more calves were born and more caribou moved into the area from the south.

*Table 1. 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, 2007.*

| Survey | Location | Area Surveyed ($km^2$)[a] | No. of Groups Observed | Total No. of Caribou Observed | No. of Calves Observed | Total Density (no./$km^2$) | Calf Density (no./$km^2$) |
|---|---|---|---|---|---|---|---|
| Early Calving | North | 248 | 37 | 79 | 12 | 0.60* | 0.09* |
| (June 2 & 4–5) | South | 470 | 279 | 530 | 39 | 2.12* | 0.16* |
| Late Calving | North | 248 | 135 | 825 | 237 | 3.33 | 0.96 |
| (June 11–12) | South | 470 | 558 | 4,488 | 1,061 | 9.55 | 2.26 |
| Early Postcalving | North | 254 | 65 | 516 | 100 | 2.03 | 0.39 |
| (June 18) | South | 594 | 273 | 3,442 | 469 | 5.79 | 0.79 |
| Late Postcalving | North | 254 | 64 | 1,362 | 199 | 5.36 | 0.78 |
| (June 24) | South | 594 | 15 | 540 | 148 | 0.91 | 0.25 |

[a] Sampling coverage was ~50% of the survey area.
* Applied Sightability Correction Factor (Lawhead and Prichard 2005) due to patchy snow cover.

The greatest numbers of caribou among the four surveys were found on the second calving survey, when 5,313 caribou were observed (Table 1) and 10,626 were estimated for the entire survey area. A week later on 18 June, 7,916 caribou were estimated to be present in the Colville East survey area (Figure 3; Lawhead and Prichard 2008). The decrease in caribou numbers between surveys likely resulted from movement of caribou eastward out of the survey area. On 18 June, the 30% of the postcalving survey area north of the

pipelines contained 19% of the groups and 13% of the individuals, proportions that were similar to the second calving survey. These proportions changed dramatically by 24 June, however, when 81% of the groups and 72% of the caribou were found north of the Alpine Pipelines. Northward movement of caribou is expected by late June as mosquitoes emerge farther inland and begin to harass caribou there, forcing them toward relief habitat near the Beaufort Sea coast. Although the first mosquitoes of the season were seen by bird researchers on the Colville River delta on June 18 and 21 (R. Johnson, ABR, pers. comm.), they did not emerge in great enough numbers to be bothersome on those days. The last week of June was quite cool and no mosquito harassment was noted until early July.

### Movements of GPS-collared Caribou

**TH collars, 2007** — None of the 12 GPS collars deployed on female caribou in July 2006 moved into areas near the Alpine Pipelines in 2006 (Lawhead and Prichard 2007a). Eight collared caribou traversed the southern edge of the Colville East survey area during fall migration in October 2006 and crossed the Colville River to the east, well south of the Alpine Pipelines, subsequently continuing east toward the Dalton Highway and Trans-Alaska Pipeline. During spring migration 2007, one GPS-collared caribou (collar 0624) crossed the Alpine Pipelines. After moving north along the eastern bank of the Colville River on 7 June, she crossed the Alpine Pipelines near the HDD river crossing on 8 June and moved north for several kilometers before heading west across the CD-4 access road south of the main Alpine facilities and continuing toward the calving range near Teshekpuk Lake. 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. One of those (collar 0702) moved onto the delta on 27 July 2007. During 1–6 August, 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 moving off the delta to the west on 7 August.

## Discussion and Conclusions

The combined results of systematic aerial-transect surveys and telemetry data from GPS-collared caribou provided indirect and direct evidence, respectively, of crossings of the Alpine Pipelines in 2007. Caribou densities were higher south of the Alpine Pipelines during calving and early postcalving, but were higher north of the pipelines later during the postcalving survey on 24 June (Table 1). Caribou densities were uniformly low in all distance categories 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 4). Examination of caribou distribution during calving (Figures 1 and 2) 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. The general pattern of caribou distribution during the 2007 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 movements of GPS-collared caribou have previously demonstrated, CAH caribou crossed the Alpine Pipelines frequently (Lawhead and Prichard 2006a, 2007a). Northward crossings of the pipelines occurred during May and June as caribou moved toward the coast during the calving and postcalving periods, especially after mosquito harassment began. Most crossings 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 ebb and flow of insect harassment, but movements through specific areas are determined by complex interactions involving previous locations of the caribou; current 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 will be limited by the presence of development infrastructure or activity (Murphy and Lawhead 2000). The CAH GPS-collar data set 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 TH caribou, which have less exposure and experience negotiating oilfield infrastructure, suggest that they also 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, because no one witnessed the encounters and other factors potentially affecting pipeline crossings (such as snow cover, weather conditions, insect activity, intraspecific behavioral interactions) were undocumented. 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.

## References Cited

Cameron, R. D., D. J. Reed, J. R. Dau, and W. T. Smith. 1992. Redistribution of calving caribou in response to oil field development on the Arctic Slope of Alaska. Arctic 45: 338–342.

Cronin, M. A., W. B. Ballard, J. Truett, and R. Pollard. 1994. Mitigation of the effects of oil-field development and transportation corridors on caribou. Final report to the Alaska Caribou Steering Committee, prepared for Alaska Oil and Gas Association, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, and the North Slope Borough, by LGL Alaska Research Associates, Inc., Anchorage. 24 pp. + appendices.

Curatolo, J. A., and S. M. Murphy. 1986. The effects of pipelines, roads, and traffic on the movements of caribou, *Rangifer tarandus*. Canadian Field-Naturalist 100: 218–224.

Dau, J. R., and R. D. Cameron. 1986. Effects of a road system on caribou distribution during calving. Rangifer, Special Issue No. 1: 95–101.

Lawhead, B. E. 1988. Distribution and movements of Central Arctic Herd caribou during the calving and insect seasons. Pages 8–13 in R. Cameron and J. Davis, editors. Reproduction and calf survival: Proceedings of the Third North American Caribou Workshop. Wildlife Technical Bulletin No. 8, Alaska Department of Fish and Game, Juneau.

Lawhead, B. E., and A. K. Prichard. 2005. Mammal surveys in the Greater Kuparuk Area, northern Alaska, 2004. Report to ConocoPhillips Alaska, Inc. and the Greater Kuparuk Area, Anchorage, by ABR, Inc., Fairbanks. 34 pp.

Lawhead, B. E., and A. K. Prichard. 2006a. Data report for Alpine pipeline caribou surveys, 2004–2005. Letter report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks. 7 pp.

Lawhead, B. E., and A. K. Prichard. 2006b. Mammal surveys in the Greater Kuparuk Area, northern Alaska, 2005. Report to ConocoPhillips Alaska, Inc. and the Greater Kuparuk Area, Anchorage, by ABR, Inc., Fairbanks. 33 pp.

Lawhead, B. E., and A. K. Prichard. 2007a. Data report for Alpine pipeline caribou surveys, 2006. Letter report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks. 8 pp.

Lawhead, B. E., and A. K. Prichard. 2007b. Mammal surveys in the Greater Kuparuk Area, northern Alaska, 2006. Report to ConocoPhillips Alaska, Inc. and the Greater Kuparuk Area, Anchorage, by ABR, Inc., Fairbanks. 34 pp.

Lawhead, B. E., and A. K. Prichard. 2008. Mammal surveys in the Greater Kuparuk Area, northern Alaska, 2007. Report to ConocoPhillips Alaska, Inc. and the Greater Kuparuk Area, Anchorage, by ABR, Inc., Fairbanks.

Lawhead, B. E., J. P. Parrett, A. K. Prichard, and D. A. Yokel. 2006. A literature review and synthesis on the effect of pipeline height on caribou crossing success. BLM Alaska Open-File Report 106, U.S. Department of the Interior, Bureau of Land Management, Fairbanks. 96 pp.

Lawhead, B. E., A. K. Prichard, M. J. Macander, and M. Emers. 2004. Caribou mitigation monitoring for the Meltwater Project, 2003. Third annual report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks.

Lawhead, B. E., A. K. Prichard, and M. J. Macander. 2007. Caribou monitoring study for the Alpine Satellite Development Program, 2006. Second annual report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks. 102 pp.

Lawhead, B. E., A. K. Prichard, and M. J. Macander. 2008. Caribou monitoring study for the Alpine Satellite Development Program, 2007. Third annual report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks.

Murphy, S. M., and B. E. Lawhead. 2000. Caribou. Chapter 4, Pages 59–84 *in* J. Truett and S. R. Johnson, editors. The Natural History of an Arctic Oil Field: Development and the Biota. Academic Press, San Diego, CA.

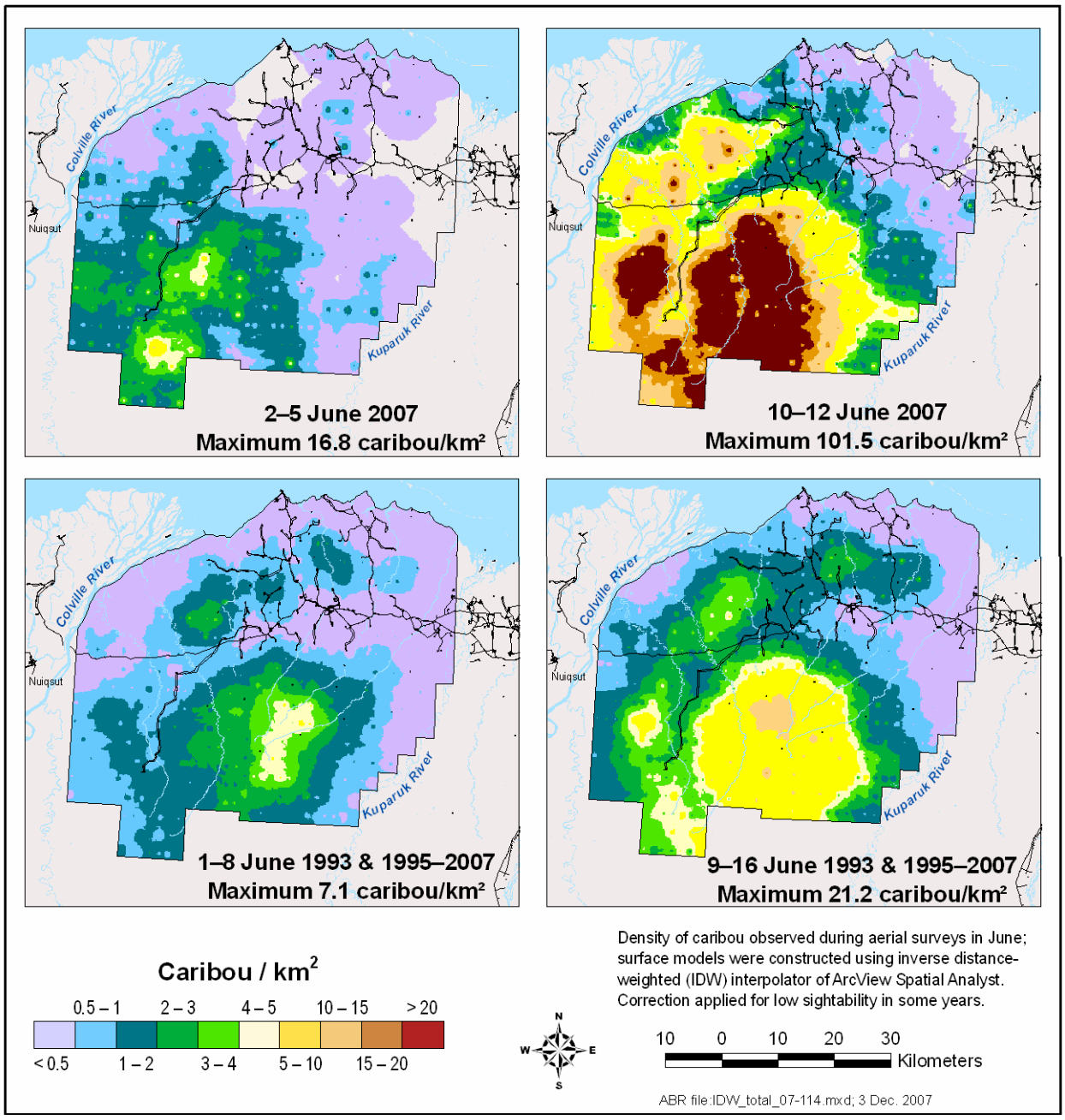


*Figure 1. Distribution and density of all caribou in the Kuparuk–Colville calving survey areas during 2–5 June and 10–12 June 2007 (top) and distribution and mean density of all caribou during early June and mid-June in the Kuparuk–Colville calving survey areas, 1993 and 1995–2007 (bottom).*

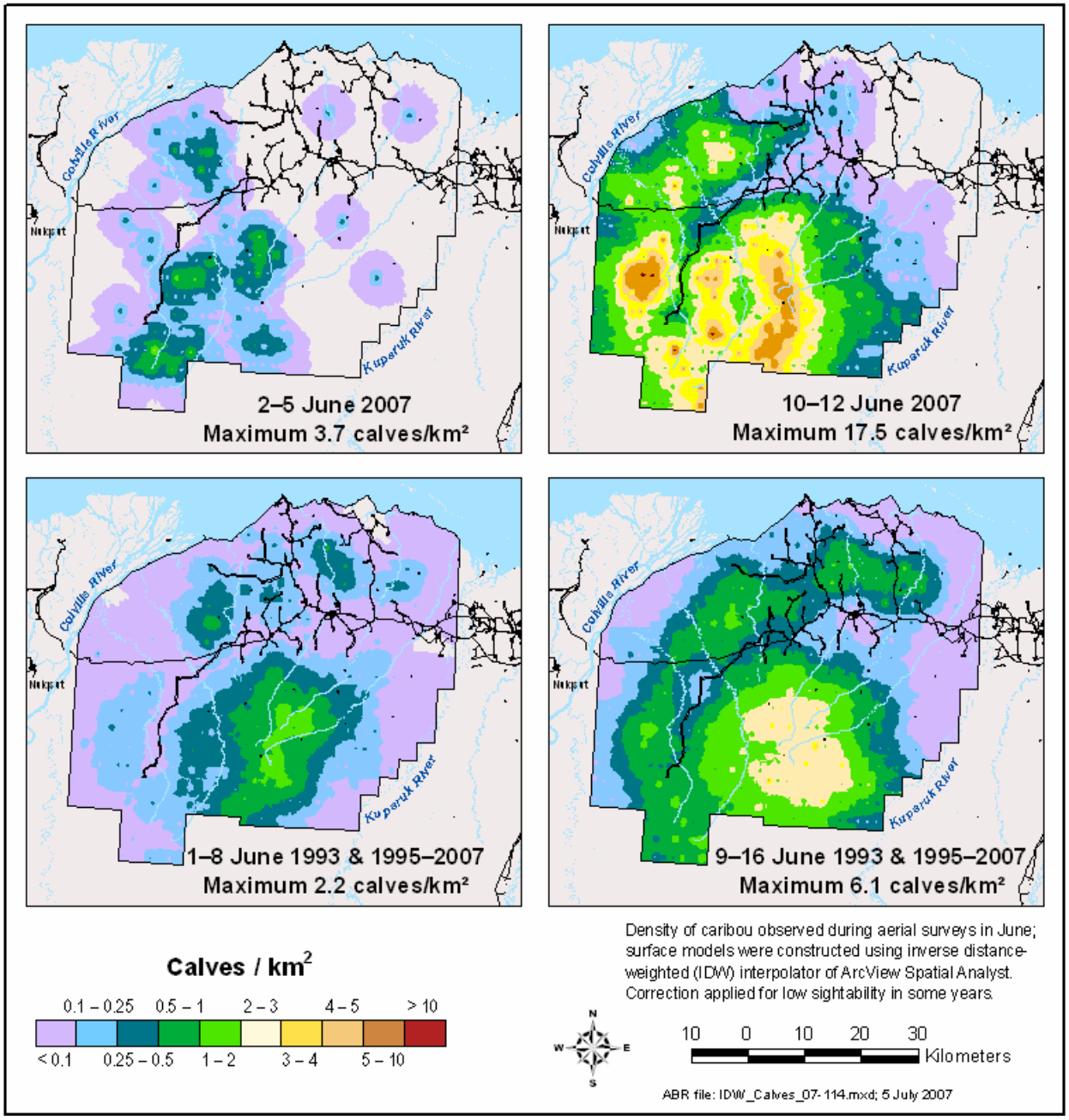


*Figure 2. Distribution and density of calf caribou in the Kuparuk–Colville calving survey areas during 2–5 June and 10–12 June 2007 (top) and distribution and mean density of calf caribou during early June and mid-June in the Kuparuk–Colville calving survey areas, 1993 and 1995–2007 (bottom).*

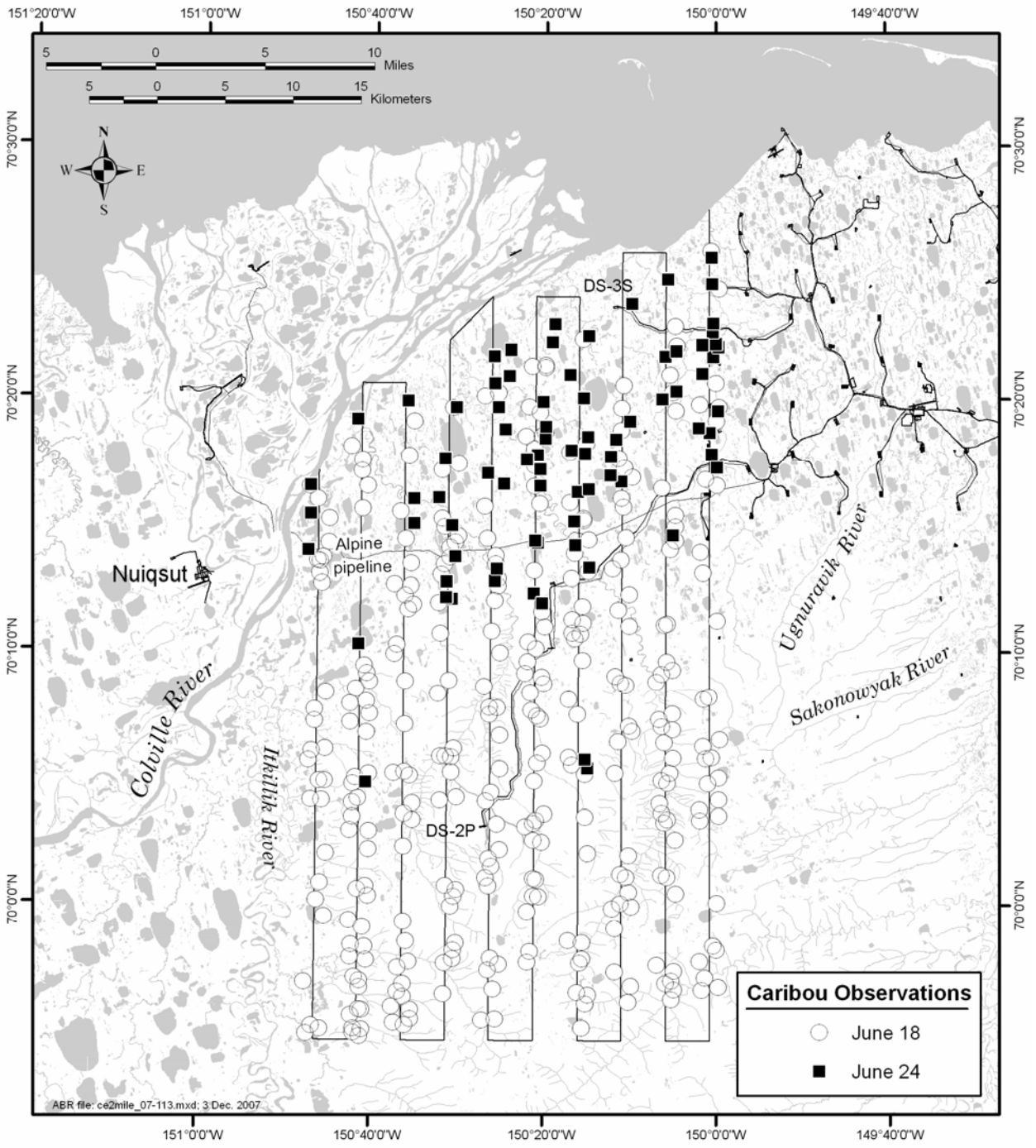


*Figure 3. Distribution of caribou groups in the Colville East survey area during two postcalving surveys in 2007.*

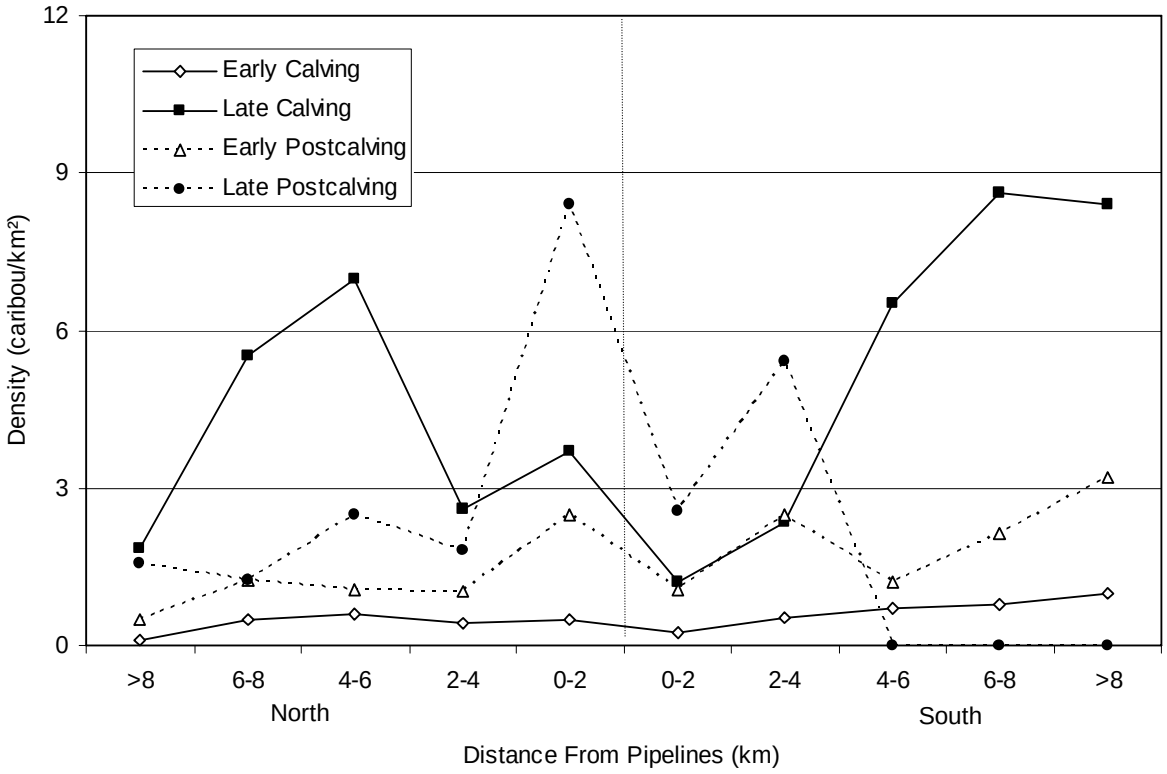


*Figure 4. Densities of caribou in different distance zones from the Alpine Pipelines during calving and postcalving surveys in the Colville East survey area, June 2007.*