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environmental research & services

December 18, 2013

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

Subject: **Data Report for Alpine Pipeline Caribou Surveys, 2013**

Dear Ms. McGhee:

This letter report constitutes our final deliverable for the 2013 project titled "Caribou along the Alpine Pipelines." It summarizes data on caribou distribution and movements in 2013 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,

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Senior Scientist

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Research Biologist

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 2013 and radio-telemetry data from 2007–2013 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.).

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, except 1994) and after construction (1999–2013) (Lawhead and Prichard 2006b, 2007b, 2008b, 2009b, 2010b, 2011b, 2012b, Lawhead et al. 2013b).

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 survey area was expanded slightly following the calving surveys to provide broader coverage for the postcalving survey.

METHODS

Two methods—aerial transect surveys and radio telemetry—have been used to examine caribou distribution and movements in the area of the Alpine pipelines in the last several decades. 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 a 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 during the latter part of the calving season in 2013 (6 and 9 June; Figure 1). The ABR survey team began the survey on 6 June but, due to inclement weather, was unable to complete it until 9 June. Another survey was flown during the postcalving period (24–26 June), 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. ABR biologists normally schedule the postcalving survey to occur before the seasonal onset of mosquito harassment, but mosquito harassment began earlier than usual in 2013 and the postcalving survey was delayed by inclement weather. Hence, by the time the survey was conducted, mosquito harassment had already begun to influence caribou distribution and movements.

Transect survey methods were described in detail previously (Lawhead et al. 2013b). 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 2013, sightability was poor in the Colville East survey area due to patchy snow cover, so the estimated densities 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 early to mid-June (6–16 June) over the period of 1993–2013 (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 2013 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 observed over the entire survey area, including

one map showing adults, yearlings, and calves combined, and another map showing only calves, to create an easily understood visual portrayal of the data. We also created IDW maps summarizing all survey years in the period before construction of the Alpine pipelines (1993 and 1994–1998) and after construction (1999–2013). To provide a broader spatial context of calving densities in the Kuparuk area, we included data from the adjacent Kuparuk South and Kuparuk Field survey areas in these maps (Lawhead et al. 2013a).

From November 2012 through October 2013, telemetry data were available for some radio-collared caribou from both herds that occur in the vicinity of the study area: the Central Arctic Herd (CAH) and the Teshekpuk Herd (TH). 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. 2013b).

Twelve female TH caribou were outfitted with GPS collars purchased by CPA 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 CPA. Six more GPS collars purchased by CPA 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 males and one female. 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 nine females were outfitted with GPS collars funded by NSB, ADFG and BLM. In June 2012, seven male caribou were outfitted with satellite collars and 17 female caribou were outfitted with GPS collars. In June 2013, five satellite collars were deployed on TH males and 14 GPS collars were deployed on TH females.

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 (Table 1). Six female caribou were collared in July 2009 (a seventh caribou died soon after collaring). Twelve female caribou were collared in June 2010, seven of which were captured near the Prudhoe Bay oilfield and the other five of which were captured west of the Kuparuk River. Two of those 12 collared CAH caribou died during the summer of 2010 and the collars from the other 10 animals were retrieved in April 2012 (one animal died in April shortly before collar retrieval). Twelve additional GPS collars purchased by CPAI were deployed on CAH females in March 2013. Two of those caribou died in May and two died in August, so only eight collars were still active in October 2013.

In all years, the TH collars were deployed in the area surrounding Teshekpuk Lake, west of the Alpine pipelines study area. 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 2012 are described in previous reports (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a, 2013).

A complete data set for the 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

Aerial Transect Surveys

Calving Survey

Caribou distribution and movements in 2013 were affected by an unusually late spring. Snow melt was delayed across much of the state, including northern Alaska. Northward migration by the CAH was delayed and, by far, most calving occurred south of our study area (E. Lenart, ADFG, pers. comm.), resulting in the lowest calving density observed in the Greater Kuparuk Area since our surveys began in 1993. During the 2013 calving survey, the highest density of caribou in the Greater Kuparuk Area occurred south of the Kuparuk facilities and east of the Meltwater Road (Figure 2). Although at much lower densities than in other years, the highest density occurred in the Kuparuk South survey area (Lawhead et al., in prep.), which has supported high-density calving in most other years since 1993. Since 2007 (except 2008), the highest densities of caribou during calving surveys were found farther west in the Colville East survey area (Lawhead et al. 2013b), but that was not the case in 2013.

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 2013.

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	CPA	June 2007	June 2008	0	12	12
	GPS	CPA	June 2008	June 2009	0	7	7
	GPS	NSB, BLM, ADFG	June 2008	Various	0	20	20
	GPS	CPA	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
	Satellite	NSB, BLM, ADFG	June 2013	–	5	0	5
	GPS	NSB, BLM, ADFG	June 2013	Various	0	14	14
CAH	Satellite	NSB, BLM, ADFG	July 2006	June 2009	0	1	1
	GPS	CPA	June 2008	July 2009	0	4	4
	GPS	CPA	July 2009	June 2011	0	6	6
	GPS	CPA	June 2010	April 2012	0	12	12
	GPS	CPA	March 2013	2015	0	12	12

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

Within the Colville East calving survey area, a total of 81 caribou (including 13 calves) were observed on transects (Table 2). After adjusting for the 50% sampling coverage and the low sightability in the survey area, we estimated that 305 caribou were present in the survey area on June 10. In comparison, the mean

estimated number of caribou observed in the same survey area during the latter portion of the calving season during 2002–2012 was 5,623 caribou (Lawhead et al. 2013a).

In Colville East, the highest 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, Lawhead et al. 2013a). In 2013, most caribou were located south of the Alpine pipelines during the calving survey. Consistent with the inland distribution of calving in 2013, just 5% of caribou groups and 4% of total caribou found in the Colville East survey area were north of the Alpine pipelines, an area that constitutes 35% of the survey area.

Postcalving Survey

Large groups of caribou moved into the Kuparuk area after calving. On 23 June, the day before the postcalving survey began, ABR biologists conducting other wildlife surveys in the area observed large groups of caribou (totaling 4,000–5,000 animals) crossing the Kuparuk River east of the study area, but very few were seen in the Colville East survey area. Because of inclement weather, we could not complete the survey until 26 June. By that time, mosquito harassment had begun and many caribou had moved north and northeast toward the Beaufort Sea coast. Large groups of caribou were observed east of the Sagavanirktok River on 27 June, suggesting continued eastward movements. On 24 and 26 June, six caribou (all adults) were seen in the expanded Colville East survey area (Table 2), resulting in an estimate of 12 caribou after adjusting for the 50% sampling coverage. The portion of the survey area north of the Alpine pipelines contained 50% 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 2013 were above the 30-year average (Lawhead et al., in prep). ABR researchers working on a different study just west of the Colville River delta reported that mosquito harassment in 2013 first began on 20 June. Mosquito harassment was moderate that day and increased to severe harassment on 21 June. Temperatures were cooler and mosquitoes were inactive on 22 June, but harassment was again severe on 23 June. Temperatures dropped and mosquito harassment abated during 23–25 June.

Movements of Collared Caribou

GPS Collars (CAH), March 2013–October 2013

The movements of GPS-collared CAH caribou before May 2012 have been described in previous reports (e.g., Lawhead and Prichard 2013). Additional collars were deployed on CAH females during 21–23 March 2013, when ADFG biologists outfitted 12 female caribou with GPS collars purchased by CPAI (Table 1). Two of those animals died in May 2013 and two died in August 2013. The collars on the remaining eight caribou all were functioning as of 31 October 2013. Of the 10 GPS collars that were active on female CAH caribou between April and October 2013, two were located near the Alpine pipelines study area. Caribou C0910 was located southwest and northeast of the Alpine pipelines in summer 2013, but did not cross them in our study area. Caribou C0810 crossed the Alpine pipelines during two periods. On 11 July, she crossed the eastern portion of the pipelines, heading north. On 22 July, she crossed back to the south side of the pipeline, again in the eastern portion, then crossed back to the north later that same day. On 23 July, she crossed the Alpine pipelines between CD-4 and Alpine and headed west.

Table 2. Number of groups and caribou observed, and caribou density estimated, to the north and south of the Alpine pipelines during calving and postcalving surveys in the Colville East survey area, 2013.

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[b]	248	2	3	1	0.023	0.008
(June 6 & 9)	South[b]	470	35	78	12	0.312	0.048
	Total[b]	718	37	81	13	0.212	0.034
Postcalving	North	254	3	3	0	0.012	0
(June 24 & 26)	South	594	3	3	0	0.005	0
	Total	848	6	6	0	0.007	0

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

GPS Collars (TH), November 2012–October 2013

The movements of GPS-collared TH caribou before November 2012 have been described in previous reports(e.g., Lawhead and Prichard 2013). Location data for 42 female TH caribou outfitted with GPS collars were available for the period from November 2012 through October 2013. Of those 42 animals, one (0924) entered the area near the Alpine pipelines (Figure 5), consistent with the more westerly distribution of the TH.

Caribou 0924 was located east of the DS-2P (Meltwater) access road during calving in 2013. She was near CPF-1 in late June and near the coast in early July. On 9 July, she crossed the eastern portion of the Alpine pipelines to the south, then crossed back to the north on 12 July. On 22 July, she moved across the Colville River delta, crossing the Alpine pipelines near CD-4. She moved far to the west in NPRA by the end of July, then slowly moved back east and was located near Nuiqsut in late August.

Satellite Collars (TH), November 2012–October 2013

The movements of satellite-collared TH caribou before November 2012 have been described in previous reports (Lawhead and Prichard 2013). Sixteen different TH caribou (12 males and 4 females) had functioning satellite (Platform Transmitter Terminal, or PTT) collars during this period. None of those collared caribou entered the study area.

Calving Distribution Before and After Alpine Construction

In the years surveyed before construction of the Alpine pipelines (1993 and 1995–1998), high densities of caribou were recorded both north and south of the future route of the Alpine pipelines, with lower densities occurring over much of the pipeline route (Figure 6). The highest preconstruction density along the Alpine pipelines route occurred near the eastern end. The area along the pipeline route also had low densities of caribou after construction, but the fact that similarly low densities were found both before and after construction suggests that the effect of the Alpine pipelines on calving distribution has been minimal.

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 2013. During the calving survey, caribou were distributed on both sides of the pipeline corridor and caribou density was higher north and south of the Alpine pipelines (Figure 4), suggesting successful crossings. The general pattern of caribou distribution during the 2013 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 2013 was lower than in some other distance zones to the north and south (Figure 4), the area along the Alpine pipelines did not support high-density calving activity in the years before construction of the pipelines (Figure 6).

During the 2013 postcalving survey, very few caribou were present in the Colville East survey area (Figure 3), probably because mosquito harassment had already begun. Large groups of caribou (totaling several thousand animals) were observed outside the survey area moving northeast toward the coast.

GPS telemetry has demonstrated previously that collared CAH caribou cross the Alpine pipelines frequently (Lawhead and Prichard 2006a, 2007a, 2008a, 2009a, 2010a, 2011a, 2012a, 2012a, 2013). 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 River delta, when mosquito harassment occurs in late June and July. Coastal areas provide good mosquito-relief habitat because they typically are cooler and windier than inland areas (Russell et al. 1993, Murphy and Lawhead 2000, Parrett 2007, Yokel et al. 2009). Caribou 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 demonstrate 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, 2013). Since 2004, CAH caribou have moved as far east as the Alaska/Yukon border during the insect season (Lenart 2011, Lawhead et al. 2011, Lawhead et al. 2012, Lawhead et al. 2013), 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 River delta. In 2013, only 10 GPS-collared CAH caribou were available to evaluate summer movement patterns. Data from those animals showed that some CAH caribou remained near the Kuparuk oilfield in summer 2013.

In 2004–2013, 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, 2013). 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 without substantial delays.

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 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 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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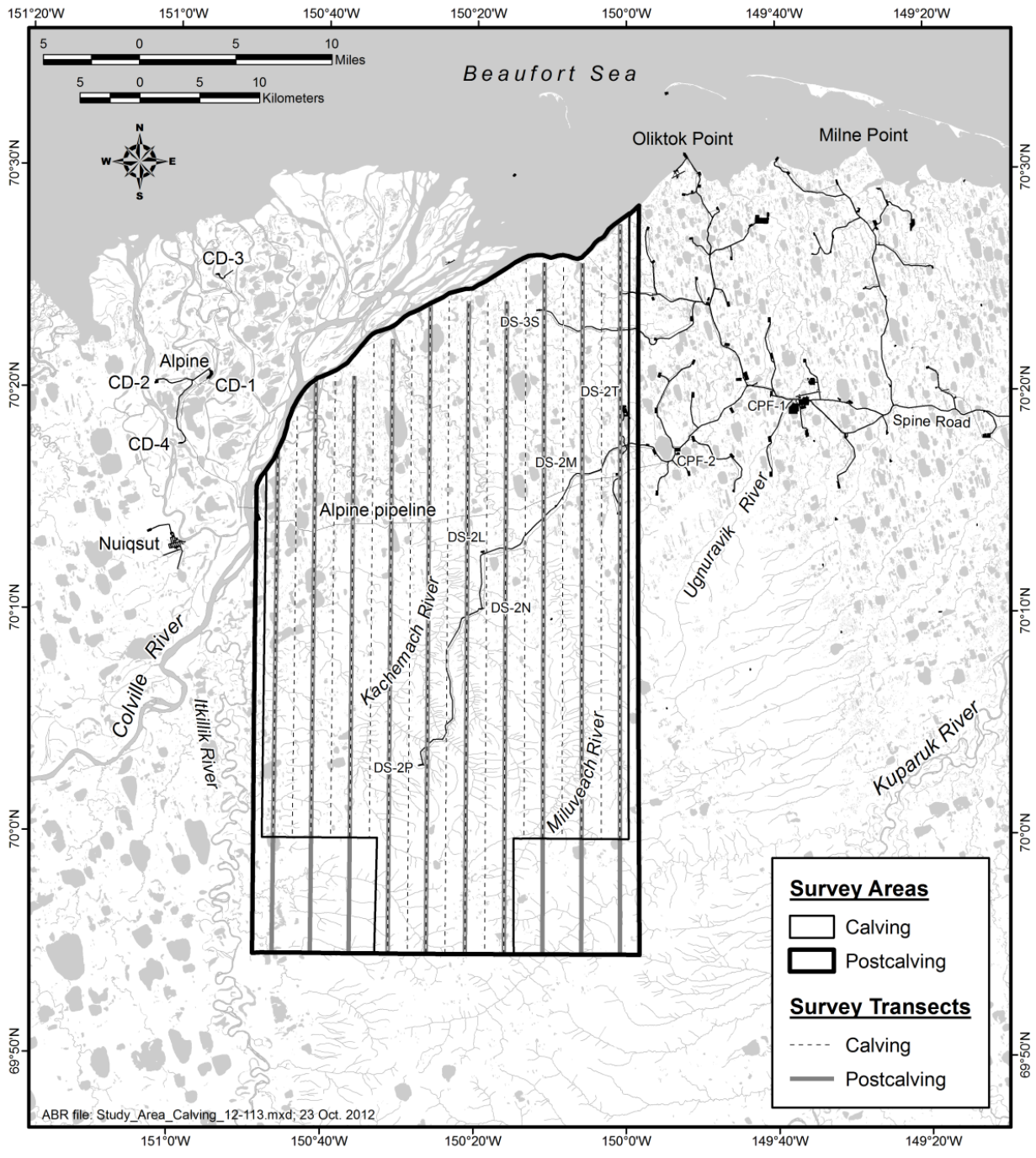

Figure 1. Colville East survey area for systematic aerial strip-transect surveys of caribou, June 2013.

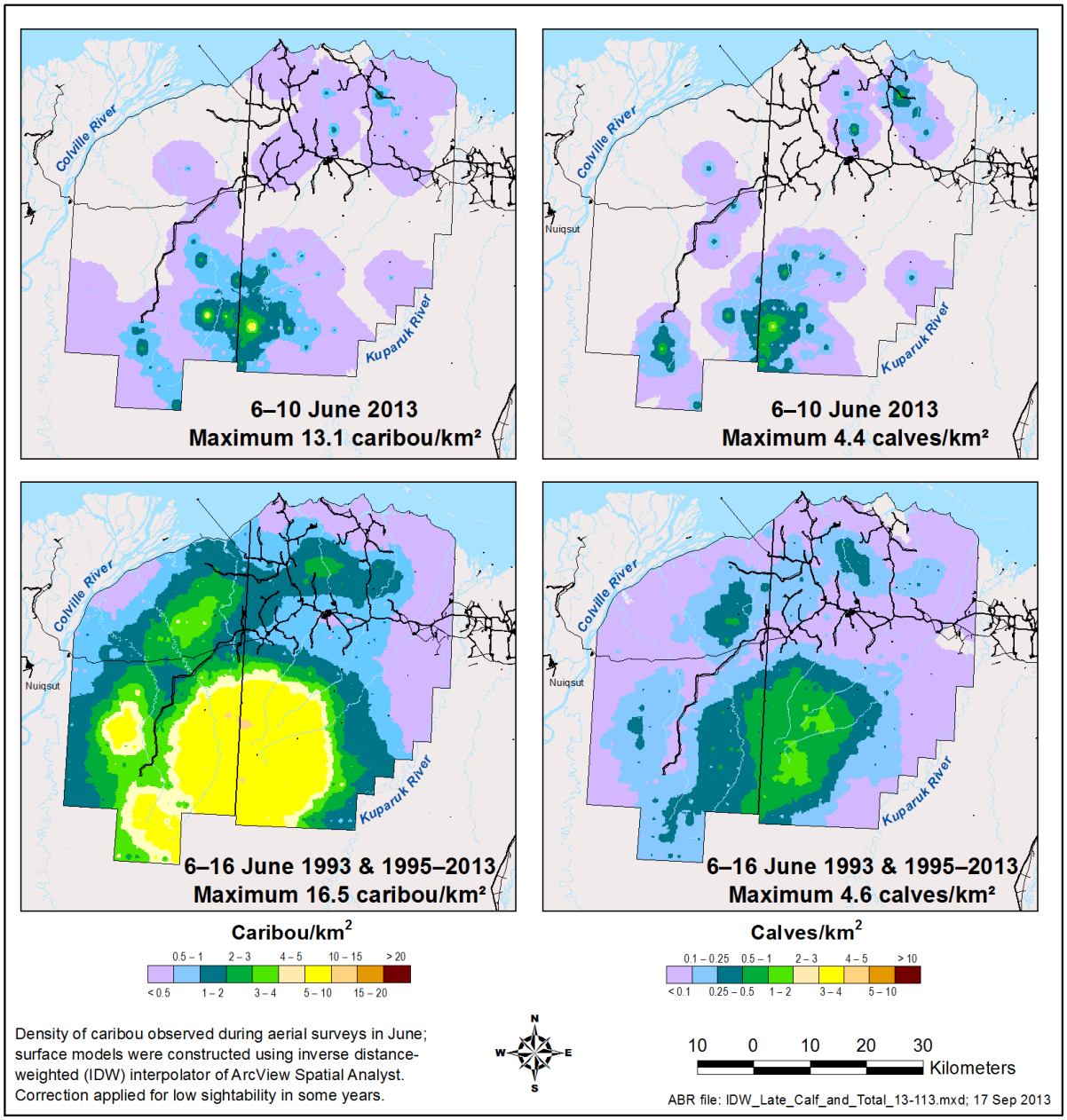

Figure 2. Distribution and density of all caribou (left) and calves only (right) in the Kuparuk–Colville calving survey areas during 6 and 9–10 June 2013 (top) and distribution and mean density of all caribou during early to mid-June in the Kuparuk–Colville calving survey areas, 1993 and 1995–2013 (bottom).

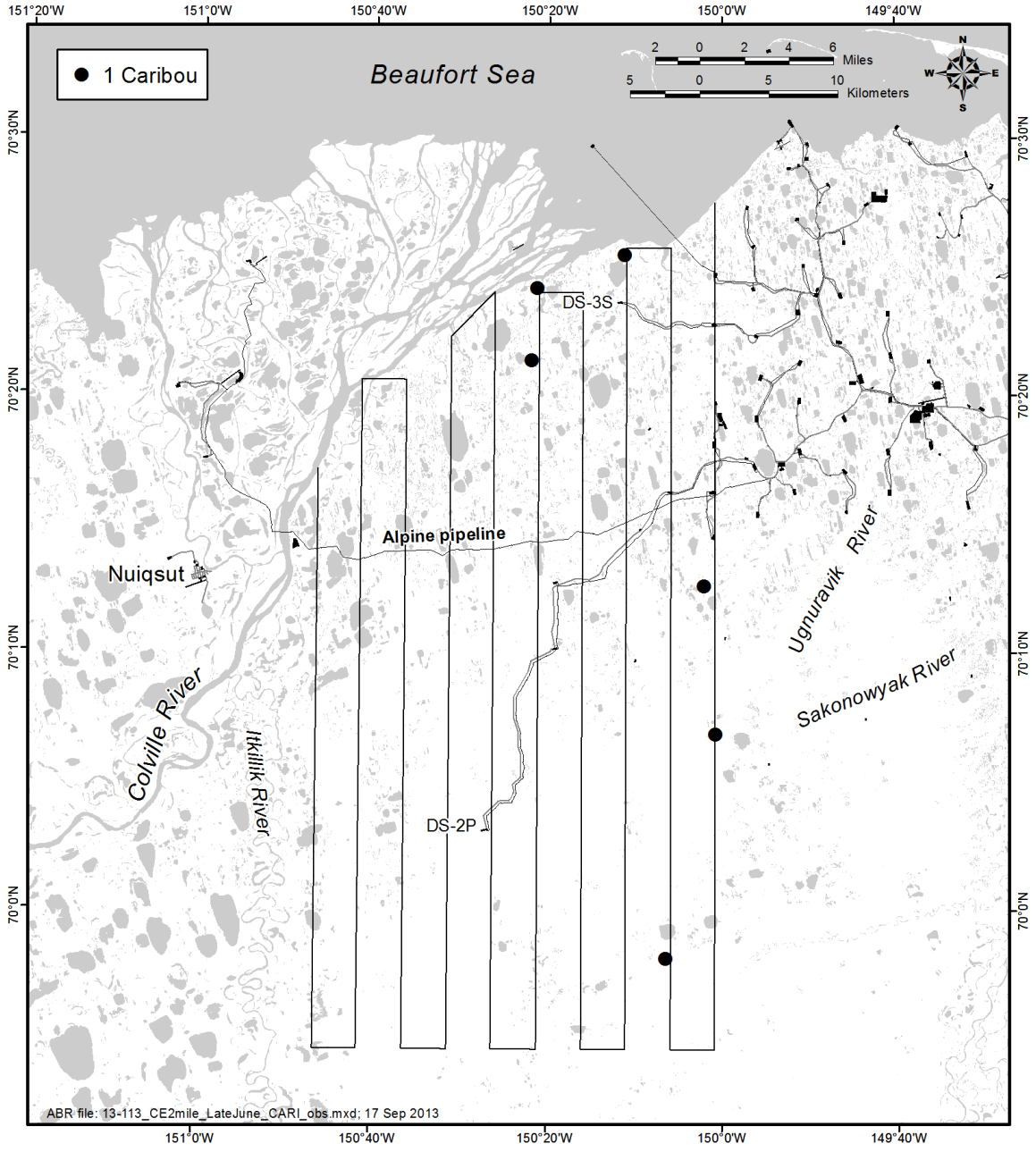

Figure 3. Distribution and size of caribou groups in the Colville East survey area during the postcalving survey on 24–26 June 2013.

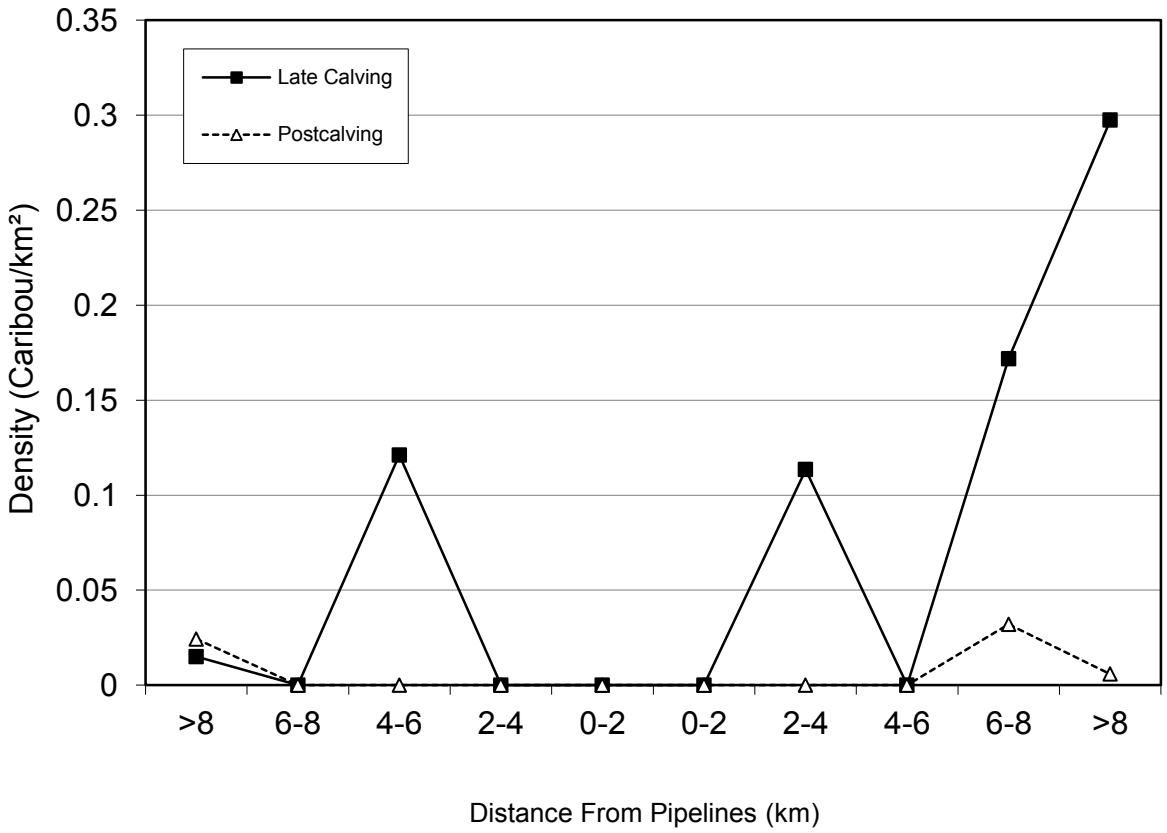

Figure 4. Densities of caribou in different distance zones around the Alpine pipelines during calving and postcalving surveys in the Colville East survey area, June 2013. Caribou numbers in the survey area during calving were multiplied by 1.88 to adjust for low sightability due to patchy snow cover (see text).

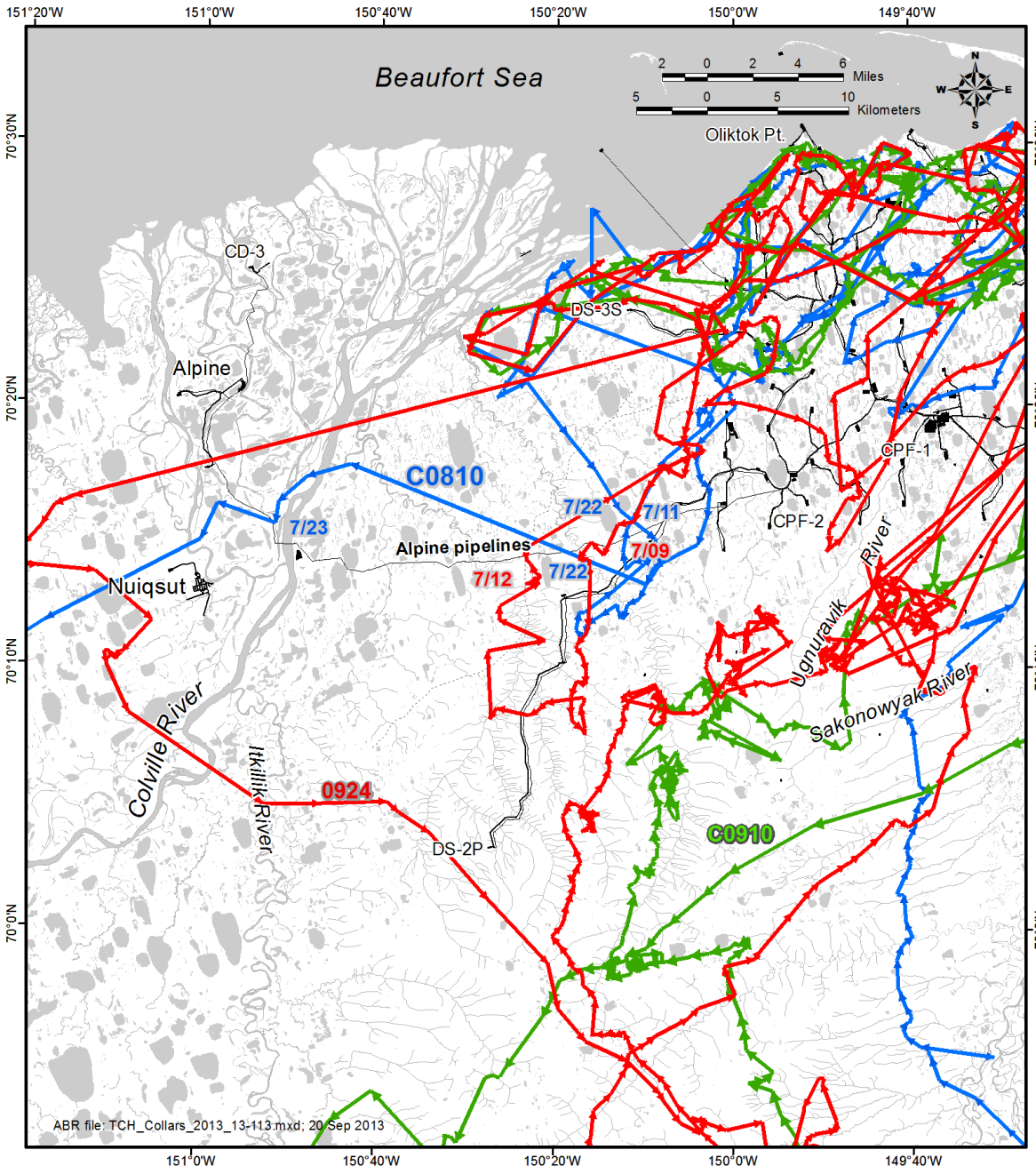

Figure 5. Movements of two GPS-collared CAH caribou (numbers C8010 and C0910) and one TH caribou (number 0924) during November 2012–October 2013 in the area encompassing the Alpine pipelines.

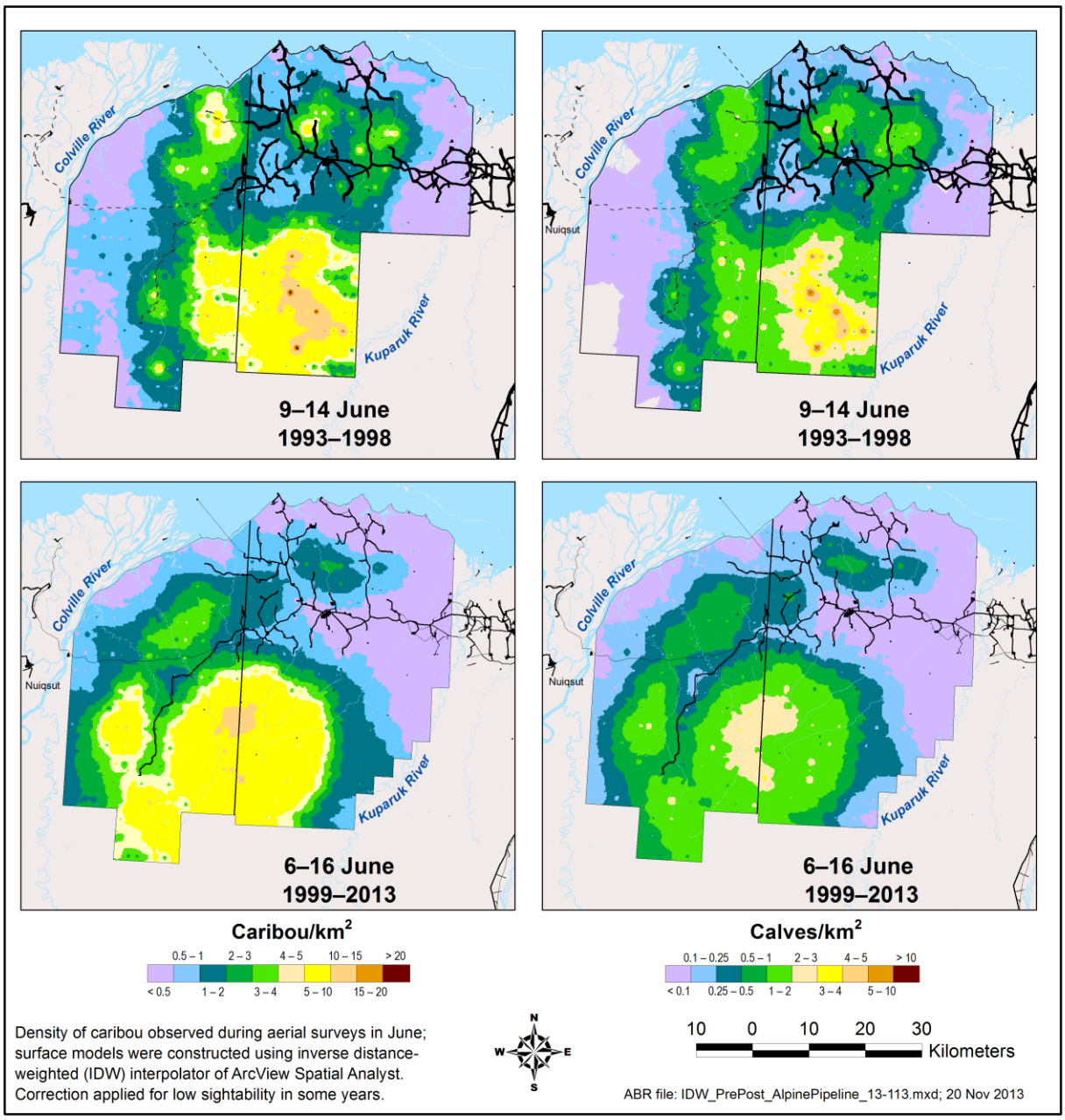

Figure 6. Distribution and density of all caribou (left) and calves only (right) in the Kuparuk–Colville calving survey areas in early and mid-June before construction of the Alpine pipelines (top) and after construction (bottom). Dashed lines denote infrastructure not yet constructed.