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A Reevaluation of Caribou Distribution Near an Oilfield Road on Alaska's North Slope

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Abstract

*Noel et al. (2004) claimed that oil development on Alaska's North Slope has not adversely affected caribou (*Rangifer tarandus*) distribution. Their argument was based on the lack of statistical difference between caribou densities at different distances from the Milne Point road, Prudhoe Bay, Alaska, USA,10–20 years after its construction. Our primary criticisms of that article are that the authors failed to include the effects of expanding oilfield infrastructure in their analysis, to incorporate 6 of 13 surveys, and to discuss data that revealed caribou largely abandoned their study area following this development. After the construction of the road, calving caribou were displaced from a previously used zone 0–4 km from the road, which subsequently increased use 4–6 km away from the road in the years spanning 1982–1987. With additional development of roads and pads in the calving grounds after 1987, affecting 92% of the study area, the remaining undisturbed fragments were too small for continued use of the area for concentrated calving. Our analysis of the Noel et al. data shows an overall gradual abandonment of the oilfield during calving and a drop in abundance of calving caribou by at least 72% within the oilfield, in spite of the fact that the total herd size had increased 4- to 5-fold during that time period. The major concentration of calving shifted to south of the oilfield, whereas such shifts in calving did not occur in the eastern portion of the Central Arctic Herd that was less affected by development.* (WILDLIFE SOCIETY BULLETIN 34(3):866–869; 2006)

Key words

caribou, development, displacement, habitat use, oil, Rangifer tarandus*, roads.*

Caribou (*Rangifer tarandus*) distribution in relation to oilfield development and roads is a highly politicized topic. Consequently, researchers investigating potential impacts of oilfield development on caribou need to be especially cognizant of presenting objective conclusions to land managers. Noel et al. (2004) compare caribou distribution around the Milne Point Road, in the Prudhoe Bay region of Alaska, USA, before and just after the building of the road, as documented by Cameron et al. (1992), with data that they collected from 1991 to 2001. The primary conclusion reached by Noel et al. (2004:757) was that "distributions of calves and adult caribou were not strongly influenced by presence of the road." They further imply that this new analysis refutes the Cameron et al. (1992) claim that oilfield development displaces caribou. We argue that the Noel et al. (2004) conclusion contradicts a large series of investigations, most recently summarized in reports from the National Research Council (NRC 2003), Cameron et al. (2005), and more important, their own data. We believe that the Noel et al. (2004) conclusion represents a potentially serious misinterpretation because they failed to incorporate new development in their analyses, to use nearly half of their survey data, and to discuss the bulk of their results revealing an abandonment of the study area. We demonstrate, using their original data, that the abandonment of this important calving ground area coincided with progressive development.

New Development

Since the initial study by Cameron et al. (1992), many changes have taken place in the Milne Point area and with the Central Arctic Herd (CAH). Numerous new drill pads and spur roads have been developed. These new developments within the study area, though ignored by Noel et al. (2004), have changed traffic patterns in the area and substantially increased the area affected by roads and pipelines. Road density in the study area has increased from approximately 0.1 km roads/km^2 to nearly 0.2 km roads/km^2, which led to 92% of the study area becoming located within 4 km from roads (Fig. 1). The 8% of remaining habitat located >4 km from roads is not contiguous; rather, it is fragmented into 3 smaller areas. Several studies have documented substantial reduction in use of areas located within 4 km of roads by calving caribou (Nellemann and Cameron 1996, 1998, Cameron et al. 2002, 2005). In addition, development also occurred immediately outside of the study area. We believe this further compromises the results reported by Noel et al. (2004).

We argue that, in this case, a lack of statistical significance is not the same as lack of impact. Noel et al. (2004) used their finding of no statistically significant difference in density of caribou within 1 km of the road between pre-road (1978–1981) and recent post-road surveys (1991–2001) to support a conclusion that oilfield roads do not strongly influence distribution of calves and adult caribou. The 0–1-km zone had lower than expected use by caribou even before development (Noel et al. 2004). We believe it is possible that progressive development, which left areas more than 4 km from development in small, isolated fragments, may have in contributed to caribou abandoning the study area.

Caribou Abandonment of Study Area with Progressive Development

Although the central tenet of Noel et al. (2004) was that there are no statistically significant differences between caribou distribution in relation to the Milne Point Road before its construction and recent post-road surveys, we contend they failed to accurately discuss what their data actually did portray. We believe their data

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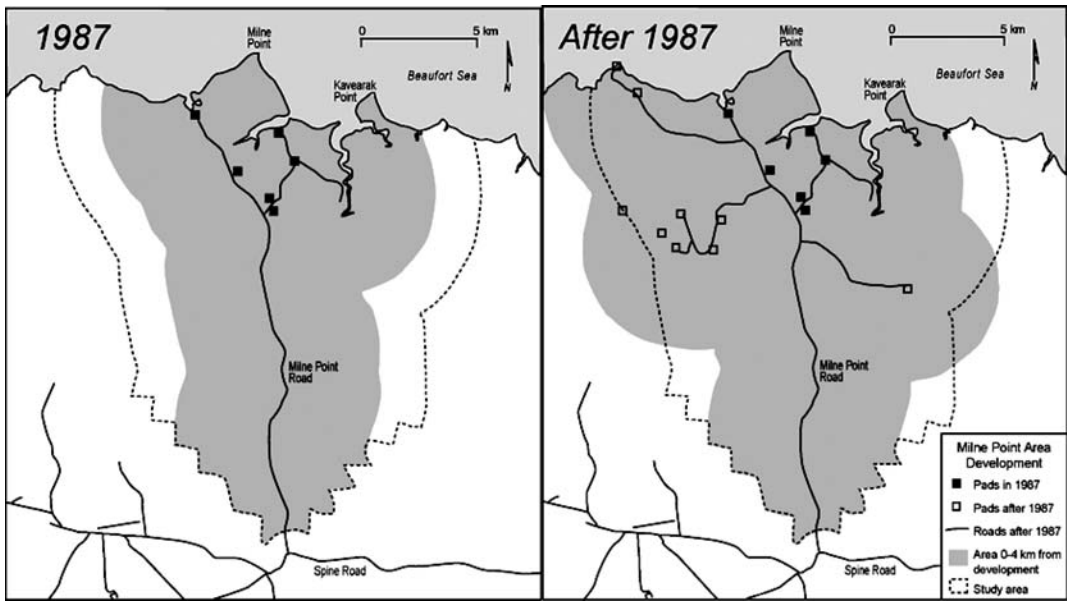

Figure 1. The change in disturbed area <4 km from development between 1987 and 2001 omitted in the Noel et al. 2004 article, which resulted in only 8% of the study area remaining undisturbed, a subsequent 72% decline in abundance of caribou calves, and gradual abandonment of the oilfield for concentrated calving, Prudhoe Bay–Kuparuk oilfield, Alaska, USA.

actually supports the findings reported by previous investigations (Cameron et al. 1992, 2005, Nellemann and Cameron 1996, 1998) that show the abundance of calving caribou in the oilfield area declined with progressive development (Noel et al. 2004, table 1).

Cameron et al. (1992, 2005) and Noel et al. (2004) reported that the total abundance of caribou in the oilfield surrounding the Milne Point Road did not decline significantly after road construction in 1982–1987, but caribou abundance within 0–4 km of the road declined significantly and increased 4–6 km from the road (Fig. 2). The high caribou and reindeer (*Rangifer tarandus*) use of an intermediate zone away from infrastructure has been documented by several studies (Nellemann and Cameron 1996, Nellemann et al. 2000, 2003, Vistnes et al. 2001, 2004, Mahoney and Schaefer 2002). We believe this is also reflected in the Noel et al. (2004) table 3. Those data depict a clear shift in use versus availability between the 2–4-km zone and the 4–6-km zone from the pre- to the early post-road period.

The Noel et al. (2004) data reveal that caribou calf density decreased in all 6 1-km distance intervals, by at least 43% (Table 1A), between the pre-road and current post-road periods. Total caribou density dropped by at least 24% in all 6 intervals as well (Noel et al. 2004). Caribou densities dropped by 75–84% in the habitat 2–4 km from the road (Table 1A), where the density of both calves and total caribou before the building of the road was greatest (Noel et al. 2004). Calf and total caribou density declined in 5 of the 6 1-km distance intervals between early post-road (1982–1987) and recent post-road periods as well (Noel et al. 2004). These declines are even more pronounced if mean densities from all 13 surveys are used rather than just the data from the 7 surveys that revealed the highest densities as Noel et al. (2004) employed (Table 1B; the Noel et al. 2004 appendix A).

The substantial declines in caribou density in the Milne Point area can be attributed to a decline in the total number of caribou and the number of calves between the pre-road and current post-road periods (Table 1). These declines came at a time when the CAH was growing rapidly. The CAH increased in numbers from approximately 6,000–27,000 individuals from 1978–2000 (Cameron et al. 2002).

We compared caribou numbers in the pre-road, 1978–1981, period (521 ± 108 caribou) with the early post-road, 1982–1987, period (598 ± 151 caribou; local redistribution) and the recent post-road, 1991–2001, period (152 ± 129 caribou; abandonment) using one-way ANOVA and all pair-wise multiple-comparison procedures using the Student–Newman–Keuls method. Our analysis showed that caribou numbers declined significantly within the oilfield ($P < 0.05$) after 1987, as development progressed. Proportionally, in relation to a herd that increased

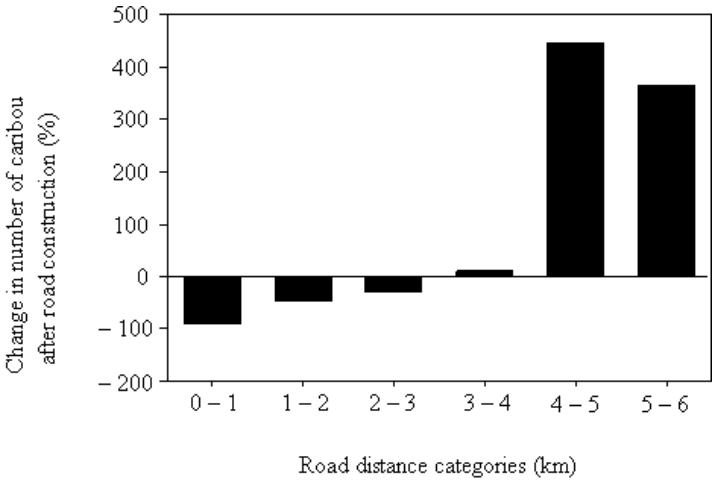

Figure 2. Relative change in abundance of caribou calves (maternal caribou) between pre-road phase (1978–1981) and early post-road development phase (1982–1987; adapted from Cameron et al. 1992 and Noel et al. 2004), Prudhoe Bay–Kuparuk oilfield, Alaska, USA.

Table 1. Change in the mean density of caribou for 6 1-km distance intervals from Milne Point oilfield access road, North Slope, Alaska, USA, from a pre-road period (1978–1981) until recent post-road period (1991–2001), from Noel et al. (2004). Paired *t*-tests for calves ($P < 0.01$) and total caribou ($P < 0.05$), respectively, show that the proportional decline is significant when considering the pre-road period as baseline for both calves and for caribou. (A) Results using only the surveys with the greatest numbers of caribou (sensu Noel et al. 2004). (B) Results using mean survey results.

(A)	**0–1 km**	**1–2 km**	**2–3 km**	**3–4 km**	**4–5 km**	**5–6 km**	**Number**
Calves	−43%	−78%	−82%	−84%	−49%	−59%	−72%
Total caribou	−34%	−65%	−75%	−81%	−24%	−48%	−63%
(B)	**0–1 km**	**1–2 km**	**2–3 km**	**3–4 km**	**4–5 km**	**5–6 km**	**Number**
Calves	−56%	−79%	−86%	−90%	−57%	−65%	−78%
Total caribou	−48%	−73%	−80%	−87%	−39%	−55%	−71%

4- to 5-fold, the decline is much larger. Our post-road mean of 152 is slightly lower than that of Noel et al. (2004). We believe this discrepancy occurred because Noel et al. (2004) only included the results of the surveys with the greatest number of caribou (mostly after 14 June) to determine the mean rather than first averaging the results for which there were multiple surveys within a year. We believe that the Noel et al. (2004) omission of 46% (6 of 13) of their survey results conceals more substantial declines in caribou numbers in the area (see the Noel et al. 2004 appendix A).

Caribou numbers declined, however, even if only those greater numbers are used (Noel et al. 2004). The Noel et al. (2004) data also show that calf density and numbers decreased proportionally more than total caribou density and numbers throughout the Milne Point area ($P < 0.05$, pairwise *t*-test; Table 1). We believe this analysis supports other studies that concluded that calving caribou were more vulnerable to disturbance than nonparturient caribou (Smith et al. 1994, Nellemann and Cameron 1996, 1998, Cameron et al. 2005).

Conclusions

We believe there are 2 important conclusions to be garnered from the work by Noel et al. (2004) and Cameron et al. (1992, 2005). First, caribou reduced their use of the zone located 0–4 km from the road after its construction. This resulted in increased caribou use of habitat 4–6 km from the road (Cameron et al. 1992, Noel et al. 2004; Fig. 2). Second, after 1987, there was a southward shift of the calving ground away from the oilfield study area. This shift dramatically reduced caribou numbers and was concurrent with 92% of the study area becoming situated within 4 km of the progressive development (Noel et al. 2004, Cameron et al. 2005; Fig. 1; Table 1). Thus, we argue that enough caribou may have left the study area, as development progressed, that it would have been nearly impossible for Noel et al. (2004) to detect a significant difference in caribou density under any circumstance. For those few caribou that remained, habitat use had been altered in all distance classes (Noel et al. 2004, table 3).

On the east side of the Sagavanirktok River, an area less affected by development, the southward shift of the concentrated calving area away from the coast was not observed. New data on reproductive performance also show much higher parturition rate on the east side compared with caribou in the oilfield (Cameron et al. 2005), directly refuting the Noel et al. (2004) claim to the contrary. The avoidance of oilfield infrastructure during calving is thoroughly documented in numerous papers (see NRC 2003 for review). We believe that the Noel et al. (2004) failure to incorporate growing oil infrastructure in their analyses compromised the utility of their conclusions. Future studies investigating the potential impacts of oilfield development need to address cumulative impacts from the entire developing oilfield complex.

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