

## Reactions of Large Groups of Caribou to a Pipeline Corridor on the Arctic Coastal Plain of Alaska

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**ABSTRACT.** Two large groups of mosquito-harassed caribou (*Rangifer tarandus granti*) were followed for 8-12 h as they repeatedly attempted to cross an elevated pipeline in the Kuparuk Development Area near Prudhoe Bay, Alaska. In 1981, 46% of a group of 917 eventually crossed beneath elevated portions of the pipeline in 26 separate attempts, 13% crossed a section of buried pipe in two attempts, 22% trotted parallel to the pipeline for 32 km and did not cross, and 19% separated from the group and were not accounted for. In 1982, 26% of a group of 655 crossed under elevated portions of the pipeline in 36 attempts, 37% crossed at a buried section in one attempt, and 37% left the main group and could not be accounted for. The majority of crossing attempts occurred near intersections of lakes with the road/pipeline complex, but crossing success was highest at a section of buried pipe isolated from road traffic.

**Key words:** caribou, pipeline, petroleum development, insect harassment, Kuparuk Oil Field

**RÉSUMÉ.** Deux groupes de caribous (*Rangifer tarandus granti*) tourmentés par des moustiques furent suivis pendant de 8 à 12 heures comme ils tentaient de traverser un pipe-line élevé dans la région de développement Kuparuk près de la baie Prudhoe, en Alaska. En 1981, 46% d'un groupe de 917 animaux traversèrent éventuellement par-dessous des sections surélevées en 26 tentatives distinctes, 13% traversèrent en deux tentatives à une section de pipe-line enterrée, 22% longèrent au trot le pipe-line sur une distance de 32 km sans le traverser et 19% se séparèrent du groupe et ne purent être retracés. En 1982, 26% d'un groupe de 655 traversèrent sous des sections surélevées du pipe-line en 36 tentatives, 37% traversèrent en une seule tentative à une section enterrée et 37% se séparèrent du groupe principal et ne purent être retracés. La plupart des tentatives de traverse eurent lieu près des croisements de lacs avec les pipe-lines et les routes, mais le taux de succès était supérieur là où les sections de pipe-line étaient enterrées et aux endroits isolés de la circulation routière.

**Mots clés:** caribou, pipe-line, développement pétrolier, harcèlement par les moustiques, champ pétrolier Kuparuk

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### INTRODUCTION

Numerous barren-ground caribou (*Rangifer tarandus granti*) of the Central Arctic Herd (CAH) (ca. 9000 head in 1981; Whitten and Cameron, 1983) use coastal portions of Alaska's Arctic Slope for calving and summer range. In late spring, most CAH cows move from inland wintering areas into the coastal zone where they remain throughout the summer, usually until early fall (Cameron and Whitten, 1979).

Weather-induced variations in insect activity strongly influence the summer movements of CAH caribou (White *et al.*, 1975; Roby, 1978). On warm, calm days beginning in late June, caribou aggregate and move northward from inland feeding areas to sparsely vegetated shore lines, river deltas, and offshore islands where cool onshore breezes offer relief from mosquitoes (*Aedes* spp.). When lower temperatures and/or stronger winds reduce mosquito activity, caribou return inland where grazing conditions are presumably more favorable. These oscillatory movements continue until late July when warble flies (*Oedemagena tarandi*) and nose bots (*Cephenomyia trompe*) replace mosquitoes as the dominant insect pests. Caribou under attack by parasitic flies tend to disperse in small groups, and movements to and from the coast become less predictable. West of the Kuparuk River, insect-related movements bring caribou into frequent contact with the roads and pipelines of a rapidly developing oil field.

Varying degrees of negative reaction by caribou to roads, traffic and/or pipelines have been reported (Tracy, 1977; Roby, 1978; Cameron *et al.*, 1979; Cameron and Whitten, 1980; Klein, 1980; Horejsi, 1981; Smith and Cameron, 1983).

Additional studies have focused specifically on the responses of caribou to roads and elevated pipelines on the Arctic Coastal Plain, but results are contradictory or inconsistent. Child (1973) reported that caribou did not pass freely beneath a simulated pipeline, whereas Curatolo and Murphy (1983) concluded that pipelines elevated 1.5 m or more did not restrict movements, provided that vehicular traffic was absent; and Fancy (1983) observed that the majority of caribou groups approaching a road and pipeline crossed the first structure encountered. These disparities are difficult to reconcile because of differences in structural configuration and the criteria chosen for crossing success (Smith and Cameron, 1985).

In this paper, we describe in detail the responses of two large, mosquito-harassed groups of caribou to a road/pipeline complex near Prudhoe Bay, Alaska.

### STUDY AREA AND METHODS

The West Sak Road (WSR) is a 32-km extension of the Prudhoe Bay Spine Road (Fig. 1) into an oil field region known as the Kuparuk Development Area (KDA). The WSR was built in winter 1977-78. During the next three years a construction camp, permanent living quarters, oil/gas processing facilities, and an airstrip were added at the Central Processing Facility (CPF-1) pad.

The Kuparuk Pipeline (KP), constructed during winter 1980-81, transports crude oil from CPF-1 to the origin station of the Trans-Alaska Pipeline, some 44 km to the east. For most of the first 30 km, the pipeline closely parallels the WSR. Vertical supports for the 50-cm pipeline are 20 m apart.

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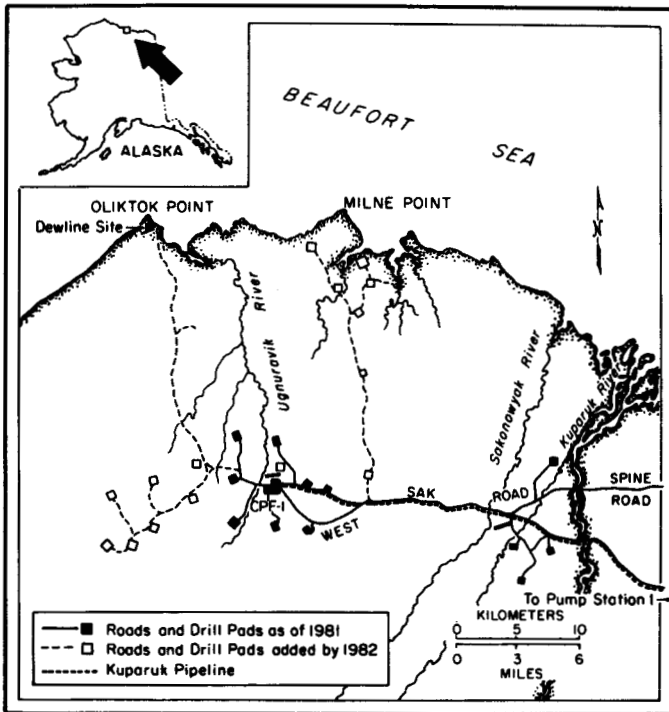


FIG. 1. The Kuparuk Development Area, 1981 and 1982.

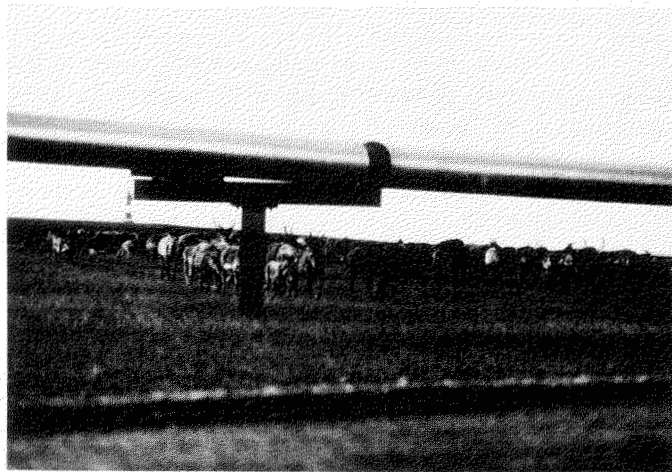


FIG. 2. Part of a group of 603 caribou adjacent to an elevated section of the Kuparuk Pipeline; 1130 h, 13 July 1982. (Photo: W. Smith).

Surface-to-pipe clearance is 1.5 m in most areas, but may exceed 2.1 m (Fig. 2), particularly where rivers and creeks are traversed.

Rates of one-way traffic on the WSR were estimated using an automatic infrared trail counter (Scientific Dimensions, Inc., Albuquerque, NM) in 1981 and through security checkpoint records in 1982. Respective mean values were 20 vehicles per hour (18 July, 0900-2200) and 21 vehicles per hour (13 July, 1200-2400). Traffic on the pipeline access road east of the Mobil Airstrip was extremely light, perhaps only two or three vehicles per hour.

Hourly weather records for Deadhorse Airport (45 km east of CPF-1) were obtained from the Arctic Environmental Information Data Center, University of Alaska, Anchorage. Based on ambient temperature and wind velocity for each hour during the two observation periods (means: 20°C and 8.2 km·h<sup>-1</sup>, 0900-2100, 18 July 1981; 13°C and 7.0 km·h<sup>-1</sup>, 1000-1900, 13 July 1982), insect harassment was moderate or severe (White *et al.*, 1975).

The caribou groups described below were originally observed during twice-daily systematic surveys of the WSR by pickup truck (inclusive dates: 15 June-7 August 1981, 1 July-5 August 1982). After completing the routine survey, we returned and followed the groups until they left the vicinity of the pipeline corridor. To minimize observer influence, we watched the groups from the greatest distance possible using binoculars or a spotting scope. Road curvature and berms, the pipeline, and terrain obstructions occasionally prevented continuous observation, but most crossing sites and numbers of caribou attempting to cross were recorded. To assist in group identification, adults and calves were counted whenever possible.

## RESULTS

### 1981

Between 0800 and 0900 on 18 July, a group of 917 caribou was first seen just east of the CPF-1 by security personnel; we first observed them at 1115 (Fig. 3). The caribou continued to mill at the same location in a large, fragmenting group until 1400. During this period, there were numerous attempts to cross the elevated pipeline to the north. All successful crossings were recorded, but the movements of numerous subgroups prevented documentation of every attempt. At 1345, 151 caribou broke away from the main group and were last seen at 1415 running east.

At 1400 the remaining 560 caribou also began to move east, paralleling the road and elevated pipeline. By the time the group reached the Sakonowayok River at 1900, an additional 256 caribou had crossed the pipeline to the north after a total of 13 attempts. The main group continued east, paused at the section of buried pipe near the Mobil Airstrip, but did not cross. During subsequent eastward movements, two groups of 32 and 54 crossed to the north and continued to trot east within 20 m of the pipe; within 15 minutes, however, most of these recrossed to the main group. At the buried section of pipeline near the Kuparuk River, 122 caribou crossed to the north. Shortly thereafter, a single adult crossed under an elevated section of pipe. The remaining 201 continued east, swam the Kuparuk River, ran parallel to the pipeline, and were out of sight at 2130.

In summary, during 12 h of observation, starting with the original group of 917 caribou, an estimated 419 (46%) crossed elevated sections of pipeline (without recrossing) in 26 separate attempts, 122 (13%) crossed buried sections of pipeline in two attempts, and 201 (22%) trotted or ran parallel to the elevated pipe for at least 32 km without crossing. Approximately 175 caribou (19%) split from the main group and

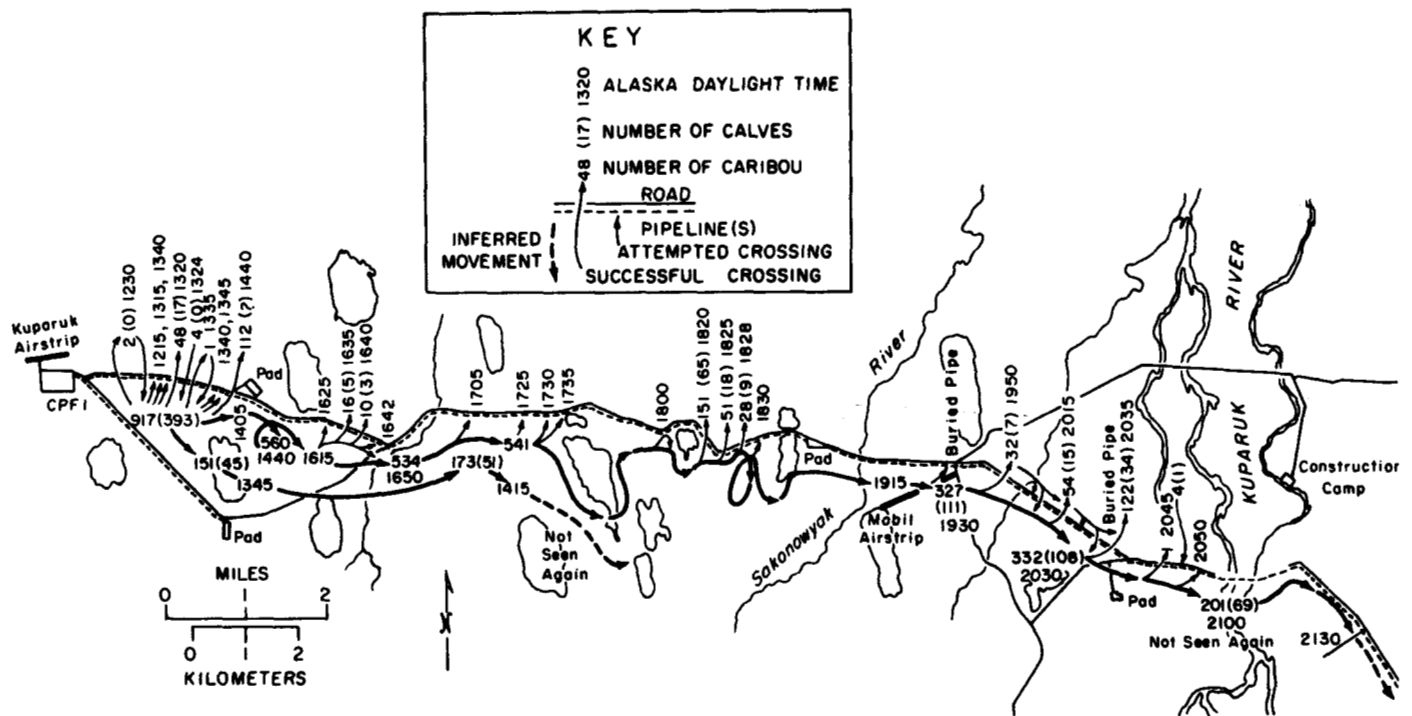


FIG. 3. Movements of caribou in relation to the Kuparuk Pipeline corridor, 18 July 1981, 0900-2130.

could not be accounted for. Overall, less than 60% of the original group was known to have crossed the KP.

## 1982

At 1030 on 13 July, a group of 515 caribou was observed milling within 20 m of the pipeline, approximately 5 km east of CPF-1 (Fig. 4a). Within an hour, they began moving eastward along the pipeline and were joined by 88 caribou from the south. After four unsuccessful crossing attempts, the group moved south approximately 2 km, along the western margin of a lake, and was joined by an additional 52 caribou. The group, now numbering 655, moved north to the pipeline, and 29 caribou crossed under the pipe. The remaining 628, including one cow-calf pair that had recrossed, turned south and ran out of sight.

Just after 1400, two groups trotted north and approached the road/pipeline (Fig. 4b). Combined, the groups were of a similar size and calf percentage as the group that had disappeared (644, 26% calves vs. 628, 24% calves), and the western group included a collared bull, YB17, that had been observed in the original group of 515 (Fig. 4a). The eastern group of 166 made four attempts to cross the pipeline, but only 10 individuals were successful. At 1445, the remainder of the group ran east out of sight. The western group of 478 made 12 crossing attempts while paralleling the road/pipeline to the west; 91 caribou moved off to the southwest, and 109 caribou in four subgroups crossed and ran north. By 1530, the remaining caribou had moved 2 km south of the pipeline.

Almost immediately thereafter, this group of 278 ran north

and attempted numerous crossings (Fig. 4c), but only 23 individuals were successful. At about 1600, the remaining 255 caribou circled a lake, ran/trotted to the east, and continued paralleling the KP for 17 km; three crossing attempts were made enroute. At 1825, the entire group, including YB17, crossed a 32-m section of buried pipeline, ran north, and subsequently crossed the WSR northbound.

To summarize, during 8 h of observation, 37 group crossing attempts were recorded. In 36 of these attempts, 169 caribou (26%) crossed northbound under the pipe (without recrossing). In one attempt, an entire group of 249 caribou (37%) crossed northbound at a buried section of pipe. An estimated 247 caribou (37%) separated from the main group of 655, and their crossing success could not be determined. In total, we observed 64% of the group crossing the road/pipeline complex.

The only other 1982 observation of a group > 100 individuals attempting to cross the KP was made on 21 July. Based on sightings at midday and again in early evening, that group of 141 bulls/adults under mosquito harassment was unsuccessful in negotiating the KP corridor.

## DISCUSSION

Group crossing attempts were generally infrequent during the midsummer periods in 1981 and 1982. Of the combined total of 1899 groups seen during systematic surveys, only 102 (5%) attempted to cross the WSR and/or KP. Similarly, of 38 groups > 100 individuals observed, only the three groups described above (8%) attempted to cross the road/pipeline (Smith and Cameron, 1985). Thus, the proportion of crossing

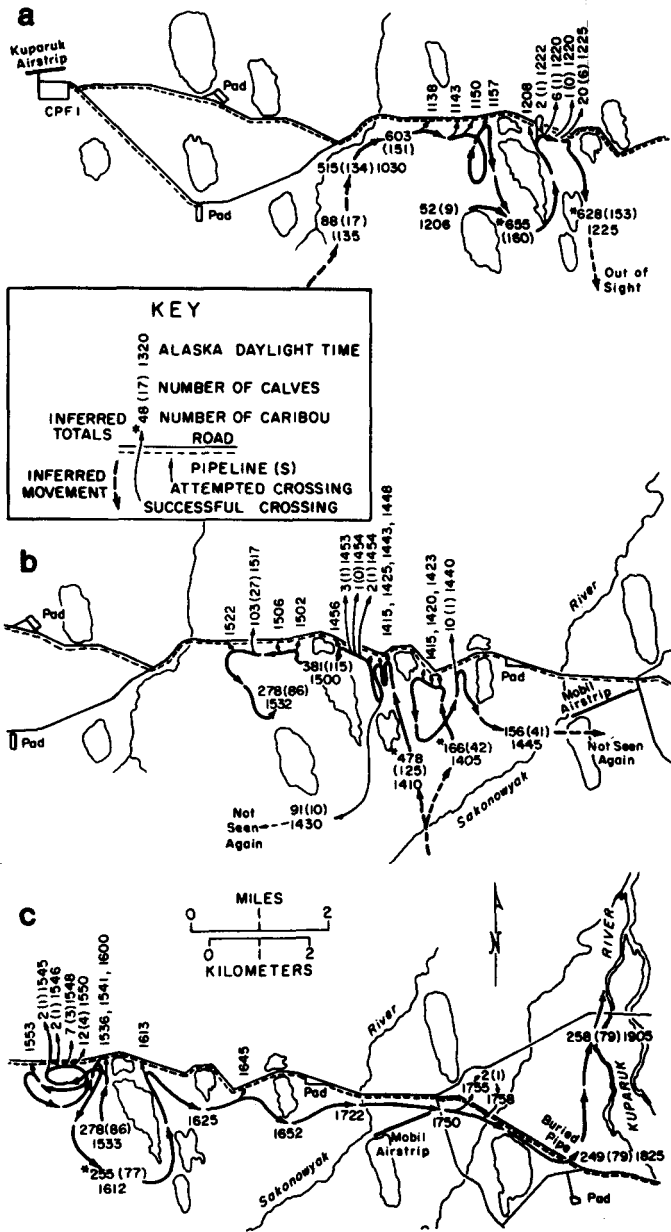


FIG. 4 Movements of caribou in relation to the Kuparuk Pipeline corridor, 13 July 1982; (a)1030-1225, (b)1405-1532, (c)1533-1905.

attempts among large groups was comparable to that for all groups observed.

The episodes detailed above indicate that large, mosquito-harassed groups of caribou do not readily cross beneath elevated pipelines. This conclusion is supported by the observations of Child (1973) and Fancy (1983) that no entire group of >100 caribou crossed an elevated pipeline or pipeline simulation when harassed by insects (Smith and Cameron, 1985). In both of the latter studies, however, numerous groups simply detoured around the relatively short structures involved (i.e., 3.1-4.8 km). In contrast, the KP is more than 40 km long, and caribou can and do move parallel to the pipeline for long distances.

For many of the caribou in both groups, interactions with

the KP resulted in a substantial increase in energy expenditure. In 1981, for example, more than 20% of the original group trotted or ran along the pipeline for 32 km, while ostensibly trying to cross to the north. This excludes several excursions to the south and a number of detours around lakes. Such unproductive activity occurred during the midsummer period of rapid growth and fattening (Dauphiné, 1976; Reimers *et al.*, 1983), when forage availability and quality are high (Chapin *et al.*, 1975; Whitten and Cameron, 1980). Extensive detours and protracted periods of running, particularly if repeated several times during a summer, would result in a net decrease in fat accumulation unless followed by compensatory increases in forage intake. Concerns regarding a possible change in energy status are consistent with Reimers's (1983) conclusion that environmental conditions during summer, including the degree of stress, are the primary determinants of growth rate and body size of *Rangifer*.

Some might argue that the caribou described in this report would have trotted or run the same total distance had they crossed the pipeline without difficulty. However, we have often observed that CAH caribou substantially decrease both frequency and speed of movement when they reach suitable insect-relief areas along the coast. Apparently the lower insect activity in these areas results in a reduction in harassment-induced movement, with a corresponding increase in feeding opportunity.

During both attempts to cross the road/pipeline, the original aggregations progressively fragmented into numerous small subgroups. Since summer aggregation tends to reduce the exposure of individuals to biting insects (Baskin, 1970), these disruptions may have increased the net susceptibility of group members to insect attack.

In both years, the majority of crossing attempts by caribou paralleling the KP/WSR occurred at or near intersections with north-south oriented lakes. Usually the lakes funneled caribou to the road where local circumstances (e.g., traffic, topography, pipe configuration) appeared to determine crossing success. Such areas should therefore be considered prime sites for placement of special pipeline-crossing structures.

Caribou were more successful crossing sections of buried pipeline than elevated sections. Combining data from both years, 37% of the caribou crossed elevated sections of pipeline in 62 attempts, whereas 24% crossed buried sections in only three attempts; it is noteworthy that buried pipe constitutes <1% of the total length of the KP. The particular buried section used by caribou (Figs. 3, 4c) was 50% wider than the next-widest buried section (i.e., 32 m vs. 21 m) and was located at least 3 km from the road and traffic. Therefore, it is not possible to determine whether crossing success was enhanced by the physical characteristics of this crossing site (e.g., width, berm height, configuration of adjacent pipe) or the absence of other disturbance stimuli (e.g., road traffic, construction activity). Nevertheless, it does appear that well-designed buried crossings, particularly those isolated from human and vehicular activity, will increase the ability of CAH caribou to negotiate the increasing number of pipelines encountered during summer movements within the KDA.

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