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E F F E C T S O F T H E T R A N S - A L A S K A P I P E L I N E O N C A R I B O U M O V E M E N T S

BY

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Project Progress Report
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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

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Job No.: 3.18R Job Title: Effects of the Trans-Alaska Pipeline on Caribou Movements

Period Covered: January 1, 1980 through December 31, 1980

SUMMARY

Results of continued aerial surveys in the Central Arctic region and of road surveys along the Trans-Alaska Pipeline (TAP) are described and compared with data from previous years. Local abnormalities in caribou distribution and group composition, resulting primarily from avoidance of the corridor by cows and calves, continue to be apparent. Avoidance by cow/calf pairs during summer has increased since 1975, and rates of crossing the corridor have remained fairly stable, well below those observed in 1975. Caribou sighting frequency declined initially, followed by a gradual increase through 1979 and a subsequent decline in 1980.

Cow/calf avoidance during fall did not become apparent until 1976, but increased thereafter through 1978, with a partial recovery in 1979. In 1980, local calf representation, caribou sighting frequency, and corridor crossing rates all decreased.

Further observations of visual- and radio-collared caribou corroborate the avoidance trends established through aerial and road surveys. Collared bulls have been sighted more frequently from the road and have crossed the TAP corridor more often than collared cows.

The Central Arctic Herd has demonstrated excellent productivity since 1977. However, the projected increase in herd size since 1977 has not been reflected in higher densities of caribou within the transportation corridor.

Development on the coastal plain is increasing at a rapid rate, and habitat options for caribou may decrease in the near future. Comprehensive regional planning of surface uses is required to minimize the undesirable effects of petroleum-related development.

CONTENTS

BACKGROUND

The Trans-Alaska Pipeline (TAP) traverses the range of a recently recognized subpopulation of caribou *(Rangifer tarandus)*, the Central Arctic Herd (CAH) (Cameron and Whitten 1979*a*). Comparisons of caribou observations along the Dalton Highway with corresponding data from the surrounding region have revealed abnormalities in the distribution and group composition of caribou associated with the Pipeline Corridor; calves are clearly underrepresented, indicating avoidance of the Corridor area by maternal groups (Cameron and Whitten 1976, 1977, 1978, 1979*c*; Cameron et al. 1979). Despite localized displacement from some habitats, herd productivity remains excellent (Cameron and Whitten 1980*c*). This report describes the results of continued research during the 1980 field season.

OBJECTIVES

In accordance with stipulations 2.5.4.1* and 2.5.3.1 of the Stipulations for the Agreement and Grant of Right of Way for the Trans-Alaska Pipeline, this project was designed to accomplish the following principal objectives:

1) To determine herd identity, general numbers, productivity, and seasonal movement patterns of caribou which range in the vicinity of the pipeline corridor.

2) To characterize movement behavior of caribou which encounter the haul road, pipeline, and construction-related activities.

* "Lessees shall construct and maintain the pipeline, both buried and above-ground sections, so as to assure free passage and movement of big game animals."

PROCEDURES

Previous reports describe the field methodology and analytical procedures which continue to be applied in aerial surveillance (Cameron and Whitten 1977, 1979*a*), Dalton Highway surveys (Cameron and Whitten 1977, Cameron et al. 1979), collaring and radio-tracking (Cameron and Whitten 1976, 1978, Appendix I), and sampling for estimates of herd productivity (Cameron and Whitten 1977, 1978).

FINDINGS AND DISCUSSION

Caribou Group Composition Determined by Aerial Survey

All 1980 composition surveys were conducted by helicopter. Except for 26 caribou in 2 groups observed during the spring survey, all caribou were classified according to standard sex and age criteria (Cameron et al. 1979). During spring, 1,314 caribou were classified, yielding 18% calves (Table 1) and a calf:cow ratio of 53:100. A fall 1979 survey was not conducted, but estimates of 20% calves and 60 calves:100 cows were projected from the 1979 summer data (Cameron and Whitten 1980*c*). Comparison of the spring estimate of 18% calves with the projected 1979 fall figure of 20% calves indicates a low overwinter mortality of calves. Relatively light snow cover, moderate temperatures, and low predation may account for this high survival.

A summer post-calving composition count was aborted on 8 August because of inclement weather. However, 570 caribou (28% calves) were classified by helicopter during a partial survey of the northwestern section of the study area (Cameron et al. 1981). Excluding a few groups in which caribou were classified only as adults or calves, a calf:cow ratio of 71:100 was calculated. This was slightly higher than the corresponding ratio observed on the calving grounds in mid-June (69:100; Cameron et al. 1981). Bulls were apparently underrepresented. Adjusting for an assumed adult sex ratio of 100 bulls:100 cows, a midsummer calf proportion of 21% was estimated (Cameron and Whitten 1980*c*, Cameron et al. 1981). This is in close agreement with summer data obtained along the West Sak Road, west of the Prudhoe Bay complex; calves comprised 20% of the more than 4,000 caribou classified (Cameron et al. 1981).

During the fall 1980 counts, we classified 1,728 caribou in 99 groups (Table 1). Calves made up 17% of the caribou observed, and the calf:cow ratio was 53:100. As in previous fall counts, more than the expected number of bulls were seen (including yearlings, 126 males:100 females. Again adjusting for an assumed adult sex ratio of 100 bulls:100 cows, a calf percentage of 18-20% was projected for the CAH (Cameron et al. 1981).

Table 1. Numbers of caribou and group composition determined by aerial survey 1980.

Inclusive Dates	Total Obs.		Total Classified[1]					Groups w/calves[2]					Groups w/o Calves[3]			
	N	G	N	G	%B	%ca	%A	N	G	%B	%ca	%A	N	G	%B	%A
4/24-5/2	1340	141	1314	136	45	18		877	61	29	28		437	75	79	
8/8[4]	570	73	570	73	22	28	16	477	47	9	33	19	93	26	89	1
10/30-11/1	1728	99	1728	99	44	17		1594	70	40	19		134	29	93	

[1] Excludes "unknowns" (unclassified as to sex or age).
[2] Total caribou in groups with one or more calves present.
[3] Total caribou in groups with no calves.
[4] Partial survey. Inclement weather precluded survey of entire area.

Note: N = number of caribou, G = number of groups, B = bulls, ca = calves, A = adults, sex undetermined

Caribou Group Composition Along the TAP Corridor

Data gathered during biweekly surveys along the Dalton Highway are presented in Table 2. Mean calf percentages for spring, summer, and fall were 4, 2, and 11% respectively, all lower than the comparable 1979 values. The spring mean of 4% calves was less than one-fourth of the percentage expected in the region, as determined by a spring aerial survey. During summer the disparity was even greater; the calf percentage observed from the road was only about one-tenth of the regional summer value of 20%. In contrast, the fall mean was approximately 60% of the expected regional value. These results are consistent with other reports that parturient and postpartum cows are particularly sensitive to disturbance (Lent 1966, Bergerud 1974, Cameron and Whitten 1980*a*), but that wariness decreases somewhat during fall (Cameron and Whitten 1980*a*, *c*).

A 6-year summary of the ratios of calf percentages observed from the Dalton Highway to those determined from corresponding aerial survey is presented in Fig. 1. For the past 4 summers calf percentages in the Corridor have been approximately 10% of the regional value, indicating that most maternal groups continue to avoid the Dalton Highway. In fall 1975, calf representation along the Dalton Highway was comparable to the regional estimate. However, during the next 3 years calf percentages along the road declined dramatically, followed by a marked increase in 1979 and a slight subsequent decline in 1980.

During summer, annual increases in caribou sighting rates occurred after a low point in 1976, and by 1979 sighting rates approximated those in 1975 (Fig. 1). In 1980, however, the summer sighting rate declined to near the 1977 value. Fall sighting rates have been erratic and are probably attributable to variable weather conditions that determine the timing of inland movements (Cameron and Whitten 1980*a*). Therefore, only the recent change in summer sighting rates might be meaningful in terms of previous distribution patterns.

Rates of caribou crossings of the Corridor in 1980 were also lower than the 1979 estimates (Fig. 1). Summer crossing rates have remained substantially below 1975 values, and there has been no tendency for a recovery during the past 5 years. Fall crossing rates were quite variable, and no consistent trends were evident. Again, annual differences in fall weather could be involved.

There are seasonal differences in the relationship between crossing rate and local caribou density. During fall, caribou generally move south to the foothills at a leisurely pace. Assuming random movements in the corridor, crossing rates would be expected to vary with the number of caribou present; this is, in fact, indicated by our data. By comparison, many summer movements are rapid and directed, with caribou moving north-south on the alluvial deposits of the Sagavanirktok River, generally in

Table 2. Numbers and group composition of caribou observed along the Dalton Highway and group composition, April-November 1980.

Survey Dates	Total Obs.		Total Classified[1]							Groups with Calves[2]							Groups w/o Calves[3]					
	N	G	N	G	%B	%C	%ca	%Y	%A	N	G	%B	%C	%ca	%Y	%A	N	G	%B	%C	%Y	%A
4/10-11	149	17	149	17	51	2	2	1	44	29	2	34	10	10	7	38	120	15	55	0	0	45
4/29-30	275	36	275	36	77	13	1	2	7	19	2	37	0	16	0	47	256	34	80	13	2	7
5/14	141	14	141	14	72	16	11	0	1	62	4	40	35	24	0	1	79	10	98	1	0	1
5/29	32	11	32	11	78	13	3	6	0	2	1	0	50	50	0	0	30	10	83	10	7	0
Spring Mean					70	11	4	2	14			44	21	17	2	17			76	8	2	14
6/10	67	23	67	23	79	1	0	11	2	0	0	0	0	0	0	0	67	23	79	1	16	3
6/25-27	433	32	433	32	78	2	1	4	15	20	2	15	20	20	5	40	413	30	81	1	4	13
7/9-10	184	26	77	25	90	1	0	1	8	0	0	0	0	0	0	0	177	25	91	1	1	7
7/24	57	30	57	30	61	21	12	5	0	20	3	5	45	35	15	0	37	27	92	8	0	0
8/8-9	155	73	155	73	83	5	3	0	10	17	3	29	29	24	0	18	138	70	92	1	0	7
8/24-25	95	31	95	31	79	11	7	1	2	18	5	5	55	40	0	0	77	26	96	0	1	3
Summer Mean					80	4	2	4	10			13	37	29	5	15			86	1	3	9
9/9-10	151	33	151	33	65	14	10	3	9	45	9	2	44	33	7	14	106	24	92	1	1	7
9/25-26	27	8	27	8	67	7	7	0	19	11	1	20	20	20	0	40	16	7	100	0	0	0
10/7	65	6	65	6	38	18	14	2	28	60	3	33	20	15	2	30	5	3	100	0	0	0
10/28-11/1	87	10	87	10	32	24	10	3	30	72	6	28	29	12	4	26	15	4	53	0	0	47
11/11-12	208	19	175	17	35	9	12	2	42	120	10	21	13	18	1	47	55	7	67	0	0	33
Fall Mean					45	13	11	2	29			22	22	18	3	35			83	1	1	16

[1] Excludes "unknowns" (unclassified as to sex or age).
[2] Total caribou in groups with one or more calves present.
[3] Total caribou in groups with no calves.

Note: N = number of caribou, G = number of groups, B = bulls, C = cows, Y = yearlings, ca = calves, A = adults

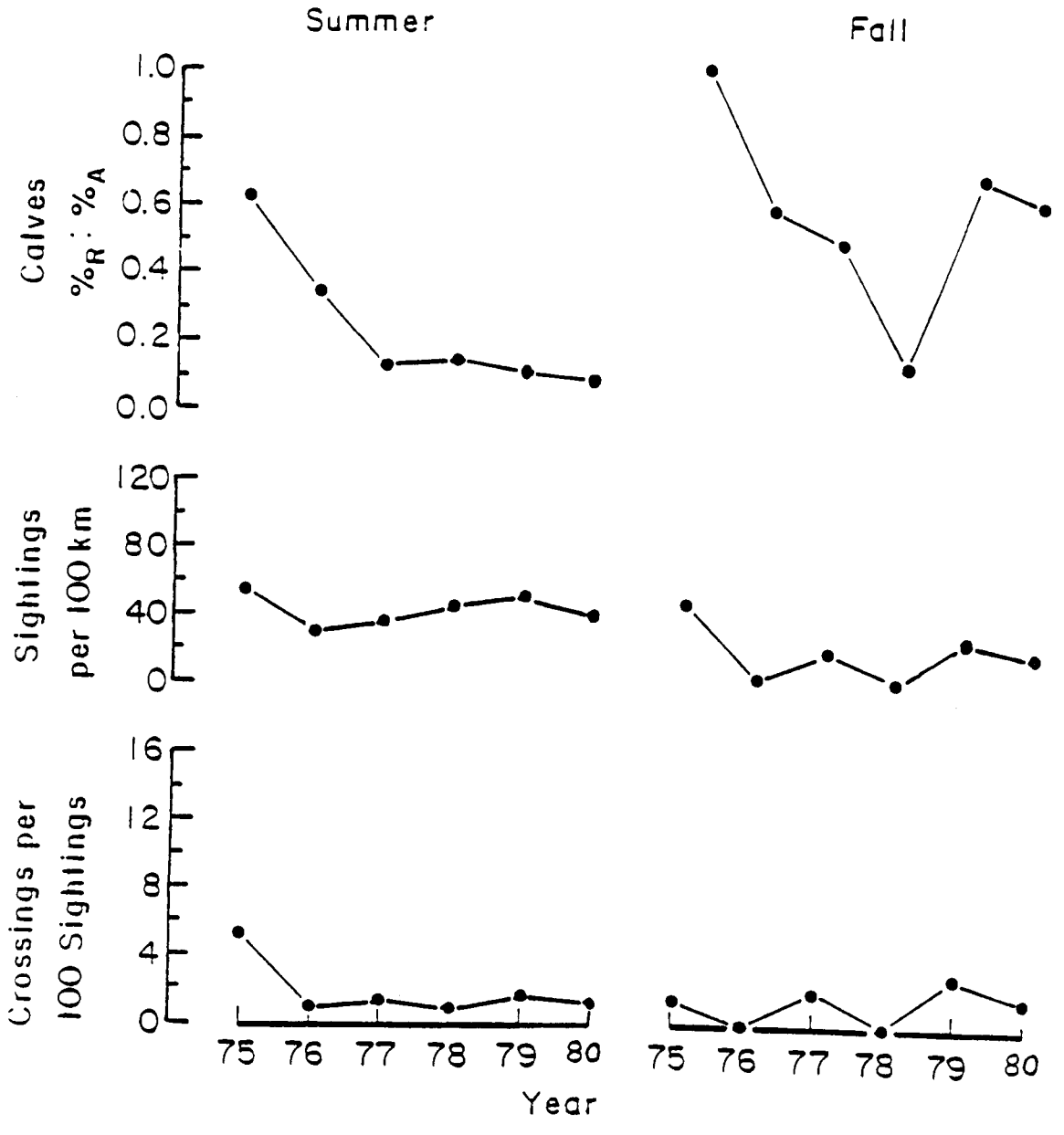

Fig. 1. Changes in relative calf representation, caribou sighting frequency, and crossing rate associated with the Trans-Alaska Pipeline Corridor, summer and fall 1975-80

Notes: $\%_R:\%_A$ = ratio of calf percentage observed from the haul road to that determined by aerial survey. The fall 1979 sighting rate was in error and has been corrected in this figure.

response to changing insect harassment. These directed movements occur parallel to, and in sight of, the Dalton Highway and may explain the fact that crossing rates remain low despite wide fluctuations in local caribou density.

The lower percentage of calves among caribou seen from the Dalton Highway apparently reflects an avoidance response by maternal groups and is not a result of a decrease in calf percentages in individual cow/calf groups (Cameron et al. 1979, 1980*a*, *c*); calf percentages in maternal groups during 1980 were as follows (from Tables 1 and 2):

	Spring	Summer	Fall
Dalton Highway	17	29	18
Regional	28	33	19

The observed difference in spring calf percentage is questionable. Comparable data from previous years are not available, and it remains to be seen if the calf percentage for maternal groups along the Dalton Highway differs consistently from the corresponding regional estimate. However, it is clear from the above comparison and previous studies (Cameron and Whitten 1980*a*, *c*) that lower overall calf percentages in summer and fall result from avoidance of the Pipeline Corridor by cow/calf groups and are not a result of fragmentation of such groups.

Average daily traffic levels along the Dalton Highway between 1976 and 1980 are presented in Table 3. There was a marked decline in traffic between 1976 and 1979. However, in 1980, traffic increased 20, 77, and 79% over the respective spring, summer, and fall values for 1979. This change was undoubtedly related to increased construction and exploration near Prudhoe Bay and was also a result of preliminary surveys for the Northwest Gas Pipeline project. It is noteworthy that during summers 1976-79 the decline in traffic was associated with an increase in caribou sighting rate, while in 1980 an increase in traffic was accompanied by a slight decline in local sighting rate, suggesting an inverse relationship.

Movements of Collared Caribou

Selected data on the movements of collared caribou between 1975 and 1979 have been incorporated in a manuscript entitled "Movements of collared caribou in relation to petroleum development on Alaska's Arctic Slope" (K. R. Whitten and R. D. Cameron). The final draft of this paper appears as Appendix I.

Status of the Central Arctic Herd

The CAH continues to be highly productive. High rates of calf survival are likely attributable to a series of relatively mild winters and low predation. The current status of the CAH is summarized in the 1981 Survey-Inventory Progress Report, submitted as Appendix II.

Table 3. Estimated daily traffic on the Dalton Highway for spring, summer, and fall from 1976-1980[1].

	1976	1977	1978	1979	1980
Spring[2]	287	383	102	65	78
Summer[3]	412	224	139	71	126
Fall[4]	249	159	71	71	127

[1] Data compiled from: Community Information Quarterly, Fairbanks, AK, October 1979, Vol. II, No. 3 and records of the Alaska Department of Transportation, Planning Division. Traffic totals were gathered at checkpoint on north side of Yukon River.
[2] March-May
[3] June-August
[4] September-November

OVERVIEW

Caribou occupancy within the TAP Corridor remains substantially below 1975 levels. In addition to comparatively low density of caribou, maternal groups are underrepresented. This is inconsistent with evidence that the CAH has increased at an annual rate of 12-18% for the past 5 years, from an estimated 4,800 adult caribou in 1976 to 6,700-7,900 adults prior to calving in 1981 (Appendix II). Since aerial survey data and the movements of radio-collared caribou have not suggested any substantial range expansion for the CAH (unpublished observations), a 40-65% increase in herd size should have resulted in a corresponding increase in caribou density in the vicinity of the Corridor. On the contrary, our observations continue to indicate local displacement of caribou and distorted group composition, ostensibly in response to construction activity, structures, and traffic in the Corridor.

Increased petroleum-related activity and structural complexity in the Prudhoe Bay Development Area have apparently resulted in a substantial reduction in caribou using that part of their traditional calving and summer range (Cameron and Whitten 1980*b*) compared with previous use patterns (Gavin 1973, White et al. 1975, unpubl. USFWS data 1975). We have presented evidence that the cow/calf segment of the CAH also avoids the Dalton Highway, yet such displacement has not resulted in reduced productivity of the CAH. A threshold level of disturbance that depresses herd productivity has apparently not been reached.

To date, the impact of industrialization on caribou has been minimal with respect to general habitat loss, industry-related disturbances, and surface use conflicts on critical habitat. However, certain aspects of continued growth and expansion of petroleum-related development should be recognized as potentially detrimental.

1) Habitat Loss: The area of oil development on the Arctic Slope is currently small in relation to total caribou habitat. Construction activity associated with the TAP was limited to a narrow corridor, and the Pipeline itself parallels the principal direction of seasonal migrations. Similarly, development in the Prudhoe Bay area has been limited spatially; only a narrow coastal strip between the west channel of the Sagavanirktok River and the Kuparuk River has been affected. However, development is proceeding rapidly in the Kuparuk Development Area (KDA), and additional lease tracts between the Sagavanirktok and the Canning Rivers are scheduled for disposal. Industrial expansion may eventually limit the availability of alternate, disturbance-free range.

2) Construction Activity: Oil exploration and construction have been restricted during critical phases of the caribou annual cycle. For example, little activity has

occurred during the precalving and calving periods in May and June. Although some of these restrictions have been stipulated in permits, others have been imposed by natural occurrences. Specifically, spring flooding of the Kuparuk River has regularly precluded access to the KDA between mid-May and early July. However, a new bridge is now in place, and long periods of limited access will no longer constitute a "de facto" moratorium on construction during the calving period.

3) Industrial Use of Critical Habitat: Important habitats, such as calving and insect relief areas, were relatively free of disturbance through 1980. CAH calving occurs on the coastal plain between the Colville and Canning Rivers, extending inland about 30 km. Calving has virtually ceased in the Prudhoe Bay area, but still occurs elsewhere along the central Arctic coast, with a particularly dense concentration occurring 15-25 km west of the Kuparuk River, and directly north of the KDA. This area is scheduled for immediate development; in fact, road construction has already begun. There are no historical records of displacement of a caribou or wild reindeer herd from traditional calving grounds and, therefore, no basis for speculation. Nevertheless, future coastal development can be expected to impact a major portion of the documented calving area of the CAH.

Planning for surface development on the North Slope lacks coordination. Provisions for caribou movements through the Prudhoe Bay complex have not been given adequate consideration. Development of individual lease tracts by independent operators has resulted in piecemeal expansion of the Prudhoe oil field. No corridors for caribou movement across contiguous leases have been established in either the planning or permitting process. Consequently, Prudhoe Bay has emerged as a maze of roads, pipelines, and facilities restricting caribou movements.

The policy for oil lease sales by the Alaska Department of Natural Resources is to schedule one high potential and two medium potential areas annually, frequently without adequate knowledge of, or attention to, wildlife values. Often leases are not contiguous even within a given lease sale; consequently, development occurs in widely separated areas, encompassing large portions of the Arctic Slope. In part, this pattern of oil development is a result of patchy distribution of petroleum deposits and the economic and logistic problems in developing specific sites. Thus, development of separate, isolated leases may cause only local disturbance, giving the impression that such activities have little regional consequence. However, when these sites are eventually connected by roads, pipelines, and processing facilities the overall physical complexity may well have substantial regional consequences to caribou.

At present, there is no mechanism for integrating petroleum development on the Arctic Slope. Coordinated regional planning is impossible. Specifically, free movements by caribou over large areas cannot be ensured without cooperative land use decisions by State and Federal agencies. Clearly, prudent development of Arctic resources will require a comprehensive North Slope development plan with effective implementation through the permitting process.

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APPENDIX I

MOVEMENTS OF COLLARED CARIBOU IN RELATION TO PETROLEUM DEVELOPMENT ON ALASKA'S ARCTIC SLOPE

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Submitted to The Canadian Field-Naturalist

ABSTRACT

Between April 1975 and May 1978, 150 Caribou *(Rangifer tarandus granti)* on Alaska's Central Arctic Slope were marked with either individually numbered collars or radio collars. Through 1979, 92% of the Caribou with radio collars were relocated repeatedly within this region. Only 59% of the Caribou with numbered collars were relocated, but comparable data on radio-collared Caribou suggest that most of the unobserved number-collared individuals remained in the study area. Resighting patterns corroborate the existence of a distinct Central Arctic Caribou Herd. A significantly higher proportion of collared bulls than of collared cows was observed from the road system associated with the Trans-Alaska Pipeline and Prudhoe Bay Industrial Area. Bulls were also resighted more frequently from the road system, and they crossed through the road corridor more often; in contrast, bull and cow resighting patterns in off-road areas were not significantly different. Thus, the cow/calf segment of the herd appeared to avoid disturbed areas more so than did bulls. The heavily developed Prudhoe Oilfield was an effective barrier to both bulls and cows.

INTRODUCTION

Construction of the Trans-Alaska Pipeline (TAP) and development of oil reserves near Prudhoe Bay focused considerable attention on the possible disruption of Caribou movements and range use patterns. Results of systematic aerial surveys conducted since 1975 have shown that this region of the Arctic Slope is inhabited by a distinct Caribou subpopulation, the Central Arctic Herd (CAH) (Cameron and Whitten 1979, 1980). Seasonal movements of the CAH are principally north-south between winter range in the northern foothills of the Brooks Range and summer/calving range on the coastal plain along the Arctic Ocean. In addition, east-west movements along the Arctic coast occur during midsummer. Surveys conducted along the Dalton Highway (previously known as the TAP haul road) through 1980 have indicated that abnormally few cow/calf pairs occupy habitats within or near the Pipeline Corridor and Prudhoe Bay Industrial Area (PBA), particularly during summer (Cameron et al. 1979); Cameron and Whitten 1980 unpubl.).

In 1975 a complementary collaring program was undertaken to examine, in greater detail, the population characteristics of Caribou in Alaska's Central Arctic region and to assess any disturbance-related deviations in seasonal distribution and movements. This report deals with pertinent data gathered from collared Caribou between 1975 and 1979.

STUDY AREA AND METHODS

The study area is on Alaska's Central Arctic Slope between the Canning and the Itkillik Rivers. The TAP Corridor is oriented north-south, roughly bisecting the study area, and the PBA lies

near the Arctic coast at the origin of the TAP. Physiography and floristics of this region have been described by Spetzman (1959) and by Whitten and Cameron (1980).

Between April 1975 and May 1978, 150 Caribou were equipped with either visual or radio-transmitter collars (Table 1). Caribou were located opportunistically, generally within 20 km of the Corridor, and darted from a helicopter with Cap-Chur equipment. Anectine (Succinyl-choline chloride) was used to immobilize Caribou in 1975, and a combination of M99 (Etorphine hydrochloride) and Rompun (Diazinone) was used from 1976 through 1978; in the latter case the antagonist M50-50 (Diprenorphine) was administered to effect recovery. Visual collars consisted of red or blue background material with conspicuous yellow numbers on the top and sides. Radio-transmitter collars (Oceans Applied Research, San Diego, CA) used in 1975 were not numbered, but some were color coded. All other radio collars (AVM Instrument Co., Champaign, IL) were attached to standard visual collars.

Table 1. Schedule of collar placement on CAH Caribou.

Date	Radio Collars	Visual Collars
April 1975	5F	10F, 10M
October 1975	4F	4F, 3M
April 1976	7F	44F, 3M
April-May 1977	12F	20F, 13M
May 1978	8F	13F, 4M
Totals	36F	91F, 33M

F = females, M = males

Caribou with visual collars were sighted incidental to routine ground surveys along the Dalton Highway (Cameron et al. 1979) and aerial surveys of the entire study area (Cameron and Whitten 1979), as well as during unscheduled trips and flights; no special effort was made to relocate any individual. Radio-collared Caribou were located on an opportunistic basis during most survey flights and were also specifically tracked from fixed-wing aircraft in November and February/March, and at approximately 10-day intervals between April and October each year. Crossings of the TAP Corridor were occasionally witnessed but were more often inferred from consecutive resightings.

Since sampling effort was presumed to be the same for all individuals, any observed differences in resighting patterns

between bulls and cows and/or between road and off-road areas should reflect corresponding differences in distribution. Chi-square contingency analysis was used to test differences in the proportions of bulls and cows resighted. Mean rates of resighting and corridor crossings were compared through Students' t-test, with the activities of individual caribou serving as the sample unit. Significance was evaluated at the 95% confidence level.

RESULTS AND DISCUSSION

Herd Identity

Transmitters used in 1975 functioned less than 8 months, but all Caribou radio-collared that year were subsequently accounted for by known mortality, recollaring, or visual sightings. All but three radio transmitters used after 1975 were still operating in 1979. Of the 36 Caribou equipped with radio transmitters, 1 emigrated from the study area, 2 were not relocated, and 11 were never seen without the aid of radio tracking equipment. Thus, only 22 (61%) of the radio-collared Caribou would have been resighted had they worn only visual collars, even though at least 33 (92%) were present in the study area.

Seventy-three of the 124 Caribou with visual collars (59%), including 22 of 33 males and 51 of 91 females, were observed at least once within the study area. These figures are similar to the proportion of radio-collared Caribou that would have been resighted without the aid of radio tracking equipment. At least 6 different visual-collared female caribou were later observed in either the Porcupine or Western Arctic Caribou Herds. Based on the radio collar findings, it is likely that most of the unobserved visual-collared Caribou remained in the Central Arctic area, however.

High rates of resighting of both radio- and visual-collared animals within the study area provide evidence for the discreteness of the CAH. The few cases of known emigration of CAH Caribou support the contention that, while Alaskan Caribou occur in separate herds, interchange is sufficiently frequent that all Caribou in the state constitute a single breeding population (Skoog 1968). To our knowledge, this is the first fully documented report of inter-herd movements in Alaska.

Caribou Occupancy of the TAP Corridor and PBA

Based on the tendency for female Caribou and their calves to avoid the PBA and TAP Corridor (Cameron et al. 1979, Cameron and Whitten 1980), one might expect differences in the resighting patterns for collared cows and bulls observed from the TAP haul road. In fact, the proportions of visual-collared bulls and cows resighted at least once during surveys conducted from the road were significantly different (61% of the males and 35% of the females), while the proportions resighted during aerial surveys

away from the road (39% of the males and 51% of the females) did not differ significantly.

The mean number of resightings per collared bull (3.6) and per collared cow (2.0) did not differ significantly. However, this comparison may be misleading, since cows apparently retained collars longer than did bulls. Most resightings of collared bulls occurred within the first calendar year, but cows were frequently seen 2 or 3 years after collaring (Table 2). Collars were attached loosely to bulls to accommodate neck swelling during rut and, consequently, may have slipped off during winter months when most adult bulls would have been antlerless. Over-winter loss of radio collars by bulls has been observed in other Alaskan Caribou (J. Davis and P. Valkenburg, pers. commun.). In contrast, collars on cows were tightly secured and were less likely to be lost during the antlerless period each summer.

Table 2. Relationship of last resighting to date of collaring for visual-collared Caribou.

Cohort	Year Collared	Last resighting (years past collaring date) <1	1	2	3	4
Males	1975	2	4	3	0	0
	1976	1	0	0	0	
	1977	9	1	0		
	1978	2	0			
		64%[1]	23%	14%	0%	0%
Females	1975	2	1	1	3	1
	1976	5	6	7	5	
	1977	8	4	3		
	1978	4	2			
		37%	25%	21%	15%	2%

[1] Percentage of last resightings occurring in year group.

Considering only Caribou that were actually resighted, and assuming collar retention only until last date seen, the resighting rates per unit of time were significantly higher for bulls than for cows ($\bar{X}$=11.9 resightings/year per individual bull vs. $\bar{X}$=4.1 resightings/year per individual cow). When these resighting rates were subdivided into observations adjacent to and away from the road, the rate for bulls along the road was significantly higher than that for cows ($\bar{X}$=9.6 resightings/year vs. $\bar{X}$=2.4 resightings/year), while the rates away from the road did not differ significantly ($\bar{X}$=5.3 resightings/year vs. $\bar{X}$=3.0 resightings/year). Clearly, a higher proportion of the collared bulls was resighted from the road system, and those resighted along the road were seen more often than were the collared cows. Away from the road system there were no significant differences

in bull and cow resighting patterns. These data are consistent with previous reports of cow/calf avoidance of the Corridor (Cameron et al. 1979, Cameron and Whitten 1980).

Crossings of the TAP Corridor

Crossings of the TAP Corridor also reflect differential use of the area by bulls and cows. A significantly higher proportion of collared bulls than of cows crossed the corridor (45% of all bulls collared vs. 24% of all cows collared). Among the collared caribou resighted, bulls also crossed more frequently ($\bar{X}$=6.3 crossings/year) than did cows ($\bar{X}$=2.1 crossings/year). However, recognizable bull groups were often observed on successive trips along the haul road, while individual cow groups were rarely seen more than once. Repeated crossings by collared bulls in such "resident" groups inflate the mean crossing rate for bulls and may not be an accurate reflection of annual crossing activity (i.e., seasonal migrations across the corridor). Nevertheless, these data indicate greater use of the area by bulls. Unfortunately, baseline data are insufficient to determine if recent crossing patterns differ from those before road and pipeline placement. A comparison of seasonal movements by radio-collared cows and bulls, disregarding observations from the road, is required to determine if bulls actually cross the Corridor more readily than do cows.

Caribou Movements in Relation to the PBA

Midsummer movements of large post-calving aggregations of CAH Caribou have frequently included a gradual eastward drift along the Arctic coast during July, followed by a rapid westward movement and inland dispersal in early August (Roseneau et al. 1974; Roseneau and Stern 1974; Cameron and Whitten, unpublished observations). In the early 1970's such movements extended through the PBA (R. White, pers. commun.). Since 1975, however, no radio-collared Caribou have been observed to move through the PBA during midsummer. On several occasions, large post-calving groups including both radio- and visual-collared Caribou have approached the oilfield complex from both the east and west but have fragmented and dispersed; only individuals or small groups (mostly adult males) actually entered the field.

CONCLUSIONS

Resightings of collared Caribou support the existence of a distinct Central Arctic Herd. The data also substantiate previous evidence that female Caribou avoid areas of petroleum-related development within their range; bulls appear to be far less sensitive to disturbance associated with this development. Although reduced occupancy of the TAP Corridor by cows and calves suggests a concomitant decrease in crossing success, further study is required to determine if the Pipeline and/or haul road constitute a serious impediment to seasonal movements of Caribou. Nonetheless, the Prudhoe Bay Oilfield does appear to disrupt midsummer movements of CAH Caribou.

ACKNOWLEDGEMENTS

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APPENDIX II

SURVEY-INVENTORY PROGRESS REPORT, CENTRAL ARCTIC HERD, 1980-81

K. R. Whitten and R. D. Cameron

In: Annual Report of Survey-Inventory Activities
(R. A. Hinman, ed.), Vol. XII (in press)

CARIBOU

SURVEY-INVENTORY PROGRESS REPORT

GAME MANAGEMENT UNIT 26B*

* Caribou harvest ticket required.

CENTRAL ARCTIC HERD

PERIOD COVERED: July 1, 1980 - June 30, 1981

Season and Bag Limit

Aug. 10 - Oct. 15 Feb. 15 - Apr. 15	Three bulls

Population Status and Trend

Prior to the early 1970's little was known about the caribou using the Central Arctic Slope of Alaska. Discovery and subsequent development of petroleum reserves at Prudhoe Bay focused much attention on possible disruption of caribou migrations through the oil field and across the Trans-Alaska Pipeline (TAP). The Department has supported intensive studies of caribou in the Central Arctic region since 1974.

Caribou in the Prudhoe Bay area were first recognized as a distinct subpopulation, or herd, in 1975. At that time, this Central Arctic Herd (CAH) numbered about 5,000, including perhaps 4,000 adult (1+ year-old) caribou. Seasonal ranges were confined to the Arctic Slope between the Itkillik and Canning Rivers.

Caribou of the CAH, particularly calves and parturient cows, were found to avoid the Prudhoe oilfield and the TAP.

In spite of displacement from portions of its traditional range and some disruption of seasonal movements, the CAH has exhibited excellent calf production and survival. The CAH was estimated to number about 6,000, with about 4,800 adults during the most recent census in July 1978. Calf production and overwinter survival, along with presumably low adult mortality typical of a lightly exploited herd, suggest that the CAH is growing at about 12-18% per year. At this rate, the herd should have numbered between 6,700 and 7,900 adults prior to calving in 1981.

Population Composition

Composition counts of the CAH have been made on a regular basis since 1976. Counts conducted during different seasons have different purposes, and are, therefore, directed at specific portions of the herd. Surveys during the calving period are confined to the calving grounds in the immediate coastal area and consist of north-south line transects; these counts measure

initial calf production. Post-calving counts of large mixed aggregations are made in midsummer; these counts permit an estimate of early calf survival and are an integral part of censusing procedures, since the entire cow/calf segment of the herd is included. Survey routes during rut and in late spring follow drainage systems throughout the CAH range and are intended to provide composition data representative of the entire herd. Because of uneven distribution of caribou, however, the results are often inconsistent and must be interpreted subjectively. At worst, these surveys measure calf survival; at best, they provide reasonable estimates of overall herd composition.

Table 1 summarizes the results of composition surveys conducted to date. All counts were conducted by helicopter except the August 1979 survey. Smaller groups (usually fewer than 30 caribou) were counted from the air, whereas larger groups were counted by landing nearby and viewing with a spotting scope. In 1980, both initial calf production and subsequent survival to yearling age were lower than in the previous 2 years. However, productivity was probably still high enough for continued herd growth, perhaps at the low end of the increase rate mentioned above.

Mortality

Between late 1976 and early 1980, harvest of CAH caribou was by registration permit only. In spite of mandatory harvest reporting requirements, take by local Native villagers was largely unrecorded. The permit system is no longer in effect, but caribou harvest tickets are required. The kill by local users within Subunit 26B and along the western boundary of Subunit 26C continues to be unreported but is probably between 50 and 100 caribou per season. Nonlocal hunters have a somewhat better reporting record, but the degree of reporting compliance remains unknown. Fifty-four people reported hunting in Subunit 26B; 47 were successful in taking 65 bulls. About half of the successful hunters flew the hunting area, and most others used road access. Reported harvest by hunters using road access was slightly higher than by those using air transportation (34 vs. 28). One caribou was taken by a hunter using a boat; the mode of transport was unspecified in 2 cases.

Most successful hunters (70%) hunted in the fall and took 1 bull caribou. Only 21 percent of the hunters killed 2 caribou each, and only 9 percent obtained the bag limit of 3 bulls. Most multiple kills were by snowmobile access in spring or by off-road vehicle transport in fall.

The TAP haul road was open only to industrial traffic and to local miners, hunting guides, or cabin owners who have property or business interests along the road. Access for hunting per se was not allowed. Nevertheless, the harvest reports show that some caribou hunters were able to gain access to the road. Big game hunting within 5 miles of the road was permissible by bow

Table 1. Summary of sex and age composition of the Central Arctic Herd, 1976-80.

Cohort	Season	Cows		Calves			Yearlings			Bulls			Total
		No.	%	No.	%	/100C	No.	%	/100C	No.	%	/100C	
1976	Post-calving (July)	572	41	247	18	43	77	6	13	493	35	86	1386
	Rut (October)	440	36	204	17	46	40	3	9	539	44	125	1223
	Spring (May)	430	48	138	16	32	--[a]	--	--	321	36	75	889
1977	Post-calving (July)	1585	41	886	23	56	227	6	14	1149	30	72	3847
	Rut (October)	198	32	127	20	64	64	10	32	239	38	121	628
	Spring (May)	198	56	80	23	40	--	--	--	73	21	37	351
1978	Calving (June)	424	44	346	36	82	166	17	39	14	1	3	964[b]
	Post-calving (July)	1831	45	997	25	54	302	7	16	913	23	50	4043
	Rut (October)	293	36	187	23	64	56	7	19	280	34	96	816
	Spring (May)	201	40	121	24	60	--	--	--	177	35	88	499
1979	Calving (June)	883	43	710	37[c]	85	216	11	26	56	3[c]	7	1923[b]
	Post-calving (August)	--	--	--	20	--	--	--	--	--	20	--	134
	Spring (April/May)	470	36	242	18	50	--	--	--	597	45	125	1340
1980	Calving (June)	356	45	247	31	69	171	22	48	13	2	4	787
	Post-calving (August)	167	29	157	28	71	32	6	19	124	22	74	570[b]
	Rut (October)	569	33	302	17	53	96	6	17	761	44	134	1728
	Spring (April/May)	371	37	125	13	34	--	--	--	502	50	135	998

[a] "Long" yearlings classified as adult cows or bulls in May surveys.
[b] Total includes some unclassified adults.

and arrow only. There are no specific data on the road-related harvest by archers.

Natural mortality in the CAH remains unknown. Wolves are currently scarce in the area, and their numbers are kept low by airborne hunters and trappers and by shooters from the road.

Management Summary and Recommendations

The CAH is a small population of caribou that has been steadily increasing since the mid-1970's. Harvest is low relative to herd size, and natural mortality appears to be low. Increased public access along the TAP road could substantially increase the harvest, but restricting the harvest to bulls should prevent overutilization, at least in the short-term. Rapidly expanding petroleum development on calving and summer range poses a serious threat to the long-term well-being of the CAH. The Department should continue to conduct studies as necessary to advise industry and other agencies on possible conflicts and to contribute toward the development of mitigative measures.

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