ALASKA DEPARTMENT OF FISH AND GAME

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COMPOSITION AND HARVEST OF THE PORCUPINE CARIBOU HERD

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SUMMARY

Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, and Yukon Game Branch personnel cooperated on a census and a sex/age composition survey of the Porcupine Caribou Herd in midsummer 1979. A modified aerial photo-direct count-extrapolation technique was used for the census. This method employs aerial photography to provide a direct count of all caribou in the post-calving aggregation; additional caribou not appearing in the aggregation are estimated through a quantitative reconnaissance of the remainder of the herd's range. Two separate photography techniques were used--direct overhead photos and oblique photos taken from alongside and above each group. Caribou movements complicated interpretation of results of the overhead technique, which required several transects to cover each group of caribou. The oblique photos gave a higher total count (105,693) of caribou. The peripheral area counts could not be fully completed, but results were sufficient to indicate that there were negligible numbers of caribou outside the photo groups.

Composition counts of each group photographed were conducted by ground observers. Results from each group were weighted according to the size of the group to estimate a herd composition of 55 calves, 16 yearlings, and 40 bulls per 100 cows. The yearling and bull ratios were both considered too low to be representative of the entire herd. This discrepancy appeared to result from error in the composition counts rather than from missing yearlings and bulls during the census.

Because some calves were undoubtedly missed in counting the photos, and because there were probably a few caribou missed

in the peripheral surveys, the midsummer population was finally estimated at 110,000 caribou. This estimate consisted of about 25,000 calves and 85,000 adults, of which approximately 45-50,000 were potentially breeding females.

CONTENTS

BACKGROUND

Skoog (1968) reviewed a large body of mostly anecdotal and qualitative historical accounts of Porcupine Caribou (*Rangifer tarandus*) Herd numbers and distribution from the late 1800's through about 1960. LeResche (1975) critically reassessed the status of the herd from about 1950 to 1972, when he conducted the first rigorous census of the herd using the aerial photo-direct count-extrapolation (APDCE) technique (Hemming 1972). Movements and distribution of the Porcupine Herd have been studied intensively most years since then (Calef and Lortie 1973, Roseneau and Stern 1974, Roseneau et al. 1974, LeResche 1975, Roseneau et al. 1975, Roseneau and Curatolo 1976, Surrendi and DeBock 1976, Russell 1977, Bente and Roseneau 1978). LeResche (1975) concluded that there were 100,000 Porcupine Herd caribou in 1972 and that, while numbers had probably not fluctuated much since at least 1950, there was no sound basis for determining any overall trend in numbers.

A second APDCE census was conducted in 1977, yielding an estimate of 105,000 caribou, but confidence limits on this estimate were too large (±28,000 caribou) to determine whether or not the population had actually remained fairly stable since 1972 (Bente and Roseneau 1978, Davis 1978). Results suggested that the number of adult females in the population may have declined, however.

The standard APDCE method depends on estimating the number of adult female caribou in post-calving aggregations and extrapolating to an estimate of the entire herd size based on the percentage of adult females determined during rut surveys. Recently, some of the assumptions implicit in the APDCE technique have been questioned (Bente and Roseneau 1978, Davis 1978), particularly because the method often leads to wide confidence intervals. The method assumes that: 1) all adult females in the herd are present in the post-calving aggregations, 2) herd composition (particularly adult females) can be accurately determined in the post-calving aggregations, 3) herd composition (particularly adult females) can be accurately determined during fall, and 4) mortality of adult females from the time of post-calving counts to the time of fall counts is zero. A requirement of assumption 1 is that caribou in the entire post-calving aggregation (all large groups) be photographed or visually counted and that caribou in the photos are accurately enumerated. Assumptions 2 and 3 depend on observers being able to accurately identify the age and sex of caribou. Failure of any of these assumptions compounds the error and broadens the confidence intervals of the final estimate (Davis et al. 1979).

Davis et al. (1979) suggested using a modified APDCE technique, in which an extensive quantitative reconnaissance of a herd's entire range is an integral part of the census. This procedure serves to test assumption 1, and assures that all segments of a herd are located for photographing or visual counting. It also provides an estimate of the number of caribou not present in the photographed groups. While not stated by Davis et al. (1979), it also follows that an estimate of herd size (for midsummer) could be generated from the photographs and the peripheral area surveys without relying on the potentially inaccurate composition counts. In the past, variability in both summer and fall composition counts has generated most of the error in final population estimates. Thus, assumption 1 in the standard APDCE census procedure is modified to require that most of the caribou in a herd appear in the large post-calving groups, and assumptions 2, 3, and 4 are replaced by the single assumption that extensive sampling of a herd's range can generate an estimate of numbers of caribou not present in the primary post-calving groups. Confidence intervals for the estimate of herd size can often be greatly reduced, since statistical error comes only from the reconnaissance sample, which represents but a small fraction of the whole herd.

OBJECTIVES

To determine the size of the Porcupine Herd and to estimate the sex/age composition of the herd.

PROCEDURES

Census Design

The 1979 census of the Porcupine Herd was conducted in several phases, essentially following Davis et al.'s (1979) modified APDCE technique. Pre-census reconnaissance of the traditional post-calving areas was used to monitor general movements and distribution of caribou until most of the herd coalesced into dense aggregations suitable for aerial photography. All large groups of caribou were then photographed, and, immediately thereafter, the remainder of the traditional summer range of the Porcupine Herd was searched to estimate the numbers of caribou not photographed. While not necessary to generate an estimate of total numbers, sex/age composition was determined for all groups of caribou encountered. This was to ensure that maximum aggregation of cows, calves, yearlings, and bulls occurred prior to photographing. It also provided an estimate of sex/age composition for the entire herd, and thus tested whether the possible decline in adult cows suggested by the 1977 census (Bente and Roseneau 1978, Davis 1978) actually occurred. Finally, composition of the final estimate served as a crosscheck on the validity of the estimate; i.e. an unreasonable composition might suggest that less than the entire herd was counted.

Pre-census Reconnaissance

Commencing in late June, a Helio Courier, a Cessna 180, and a Cessna 185 aircraft were used to systematically search the traditional post-calving range of the Porcupine Herd. Coverage extended from the Brooks Range to the arctic coast and between the Canning River in Alaska and the Blow River in the Yukon (Fig. 1). Changes in caribou movements and distribution were compiled and plotted on maps each evening. Reconnaissance continued until 3 July when the caribou were sufficiently aggregated to begin aerial photography.

Photography

Two separate methods were employed to photograph the large caribou aggregations. The Alaska Department of Fish and Game (ADF&G) used a DeHavilland Beaver equipped with a belly-mounted Fairchild T-11 9x9-inch aerial camera. Scale of the photographs ranged from 1:2000 to 1:4000. Several overlapping transects were required to photograph each large group. Overlap lines between transects and between individual photos within a transect were determined as described by Bente and Roseneau (1978), and counting proceeded as described by Davis et al. (1979). Counting error (individual observer bias) was assessed by separate observers counting the photos of one large group.

The Yukon Game Branch (YGB) photographed caribou from an oblique angle through the side windows of a Cessna 185 flown over each group. Photographs were taken with back lighting 400-900 feet above ground level and 300 to 1,200 feet horizontally from the near side of the group, depending on the width of ground covered by the group. A Canon S-AE and a Nikon F camera with motor drives and 50-mm lenses were used. To allow continuous operation through several rolls of film, one camera was reloaded while the other was in use. The camera was tilted up or down and fired often enough to insure complete coverage of the entire group, with overlap of each frame with surrounding photos. In this manner each group was photographed in a single pass rather than in several transects. The film used was KX 135 (ASA25) color slide film. Three and one-half by five-inch color prints of each slide were used to determine overlap between photographs. For actual counting, the original slides were projected onto 8.5 x 11-inch sheets of white paper. With the aid of the prints, overlap lines were transferred to the paper. Caribou were enumerated by marking each image with a pencil connected to an electric switch which kept a running tally. Whenever the observer marked the image of a calf, he also depressed a hand-held mechanical tally register. The difference between the electric tally count and the mechanical tally gave the total number of caribou 1 year of age or older on each photograph. Each frame was counted twice, either by the same person or by two different people; the two pencil-marked sheets of paper from each slide could then be compared to each other and to the original slide if the counts disagreed.

Estimation of Caribou Not Present in Post-Calving Aggregations

Past experience and impressions from the pre-census reconnaissance indicated that caribou not in the post-calving aggregation were most likely to be elsewhere on the coastal plain or in low foothill areas. Therefore, we decided to intensively sample the coastal plain and low foothills by flying north-south transects at 6-mile intervals (for ease of orientation on 1:250,000 topographical maps); the location and sex/age composition of all caribou groups within 1 mile of each flight line were recorded. In the mountains, where lower densities of caribou were expected, quadrat samples were considered more practical (see Davis et al. 1979). Twelve 144 mi^2 quadrats were selected randomly and searched for caribou. On the basis of these counts and the coverage areas of transects and quadrats relative to the respective regions they represented, estimates of total caribou not in the photographs were generated. In the remaining portion of the Porcupine Herd range (i.e. winter range) the cost-benefit ratio of searching for caribou was not considered favorable, and no further counts were conducted. Observers were alert for caribou on winter range during commuting flights to the study area, however.

Composition Counts

All composition counts were done from the ground with experienced observers using binoculars or spotting scopes to aid identification. Observers in Alaska were able to land with fixed-wing aircraft and position themselves in front of many approaching caribou, but a helicopter was necessary to land near others. Some caribou at Komakuk Beach were reached by foot from the nearby DEWline station, but all other counts in the Yukon required helicopter transport. Caribou were classified as calves, yearlings, adult cows, or adult bulls. Observers occasionally ceased counting when caribou passed in groups too dense to classify most individuals. This avoided the temptation to record only easily classified animals (i.e. calves and mature bulls). Counts were recorded with hand-held, multiple-place tally registers; subtotals were recorded at 1-, 3-, or 10-minute intervals (depending on rate of passage of the group) to allow statistical analysis of within-group variation in composition.

FINDINGS AND DISCUSSION

Pre-census Reconnaissance

On 29 June one band of about 50 caribou was seen crossing the Hulahula River in an easterly direction, while the majority of the herd had already moved east of the Jago River. After 30 June, very few or no caribou were seen between the Jago River and Camden Bay. Several hundred animals were present in the Canning River delta, but subsequent tracking of radio-collared individuals indicated that those were from the Central Arctic Herd. Meanwhile, large but fairly dispersed aggregations of caribou were forming between the Aichillik River and the Alaska-Yukon border. Fig. 2 shows the progressive coalescence of these caribou into two large, dense aggregations by the evening of 3 July. Another large group was located near the Firth River delta (Komakuk Beach), and scattered bull/yearling groups were found on the upper Crow River in the Yukon Territory (Fig. 1). Otherwise, there appeared to be no further concentrations and aerial photography commenced on 3 July.

Photo Counts

The two large, post-calving aggregations in Alaska (Turner River and Kongakut River; Table 1) were photographed by both ADF&G and the YGB on 3 July. Yukon Game Branch personnel photographed the Firth River/Komakuk group on 3 July, and ADF&G photographed the same group in a slightly different location on 4 July. The scattered bulls and yearlings on Crow River were sufficiently aggregated for aerial photography on 7 July, but only YGB was able to photograph them.

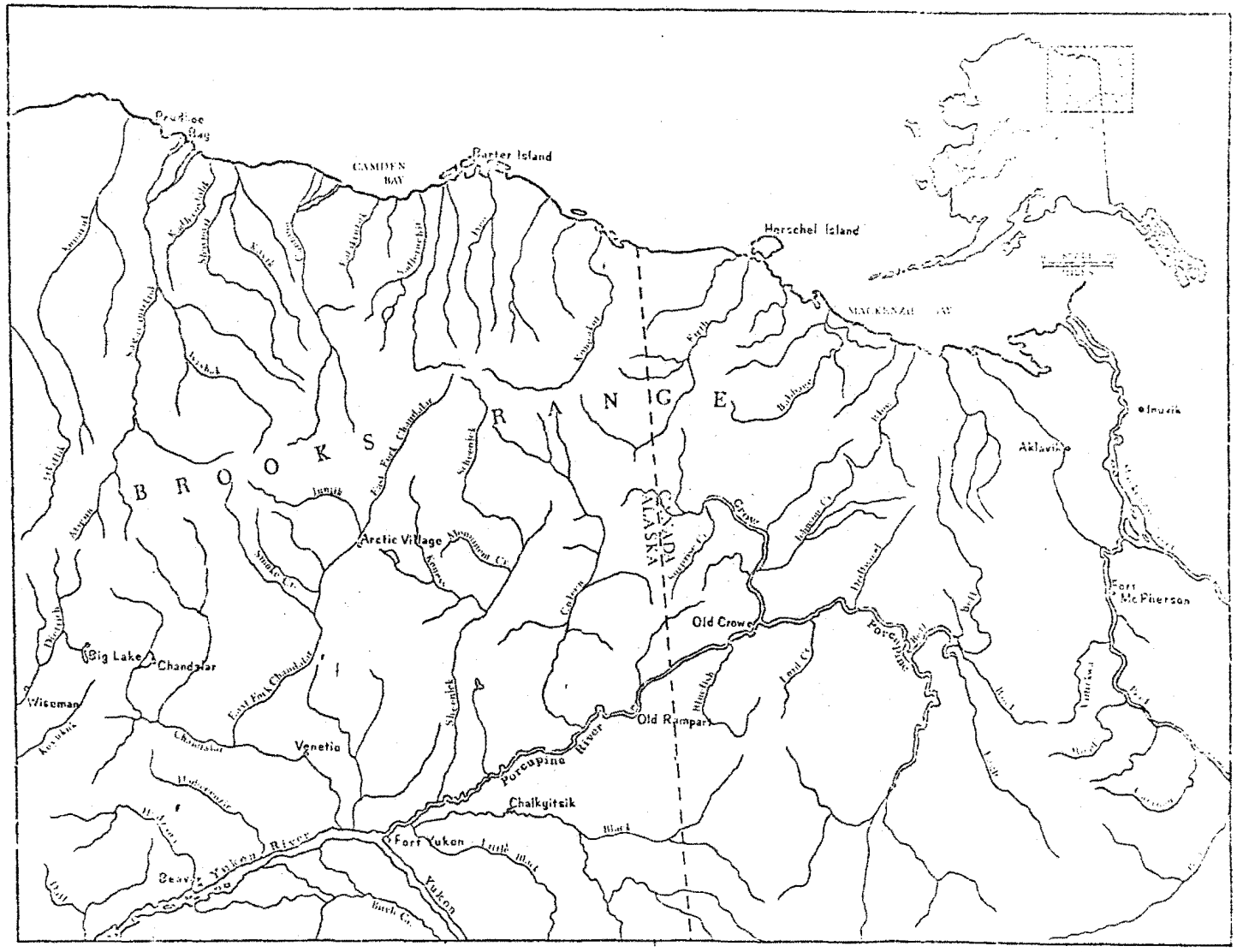

Fig. 1. Greater range of the Porcupine Herd in northern Yukon Territory and northeastern Alaska.

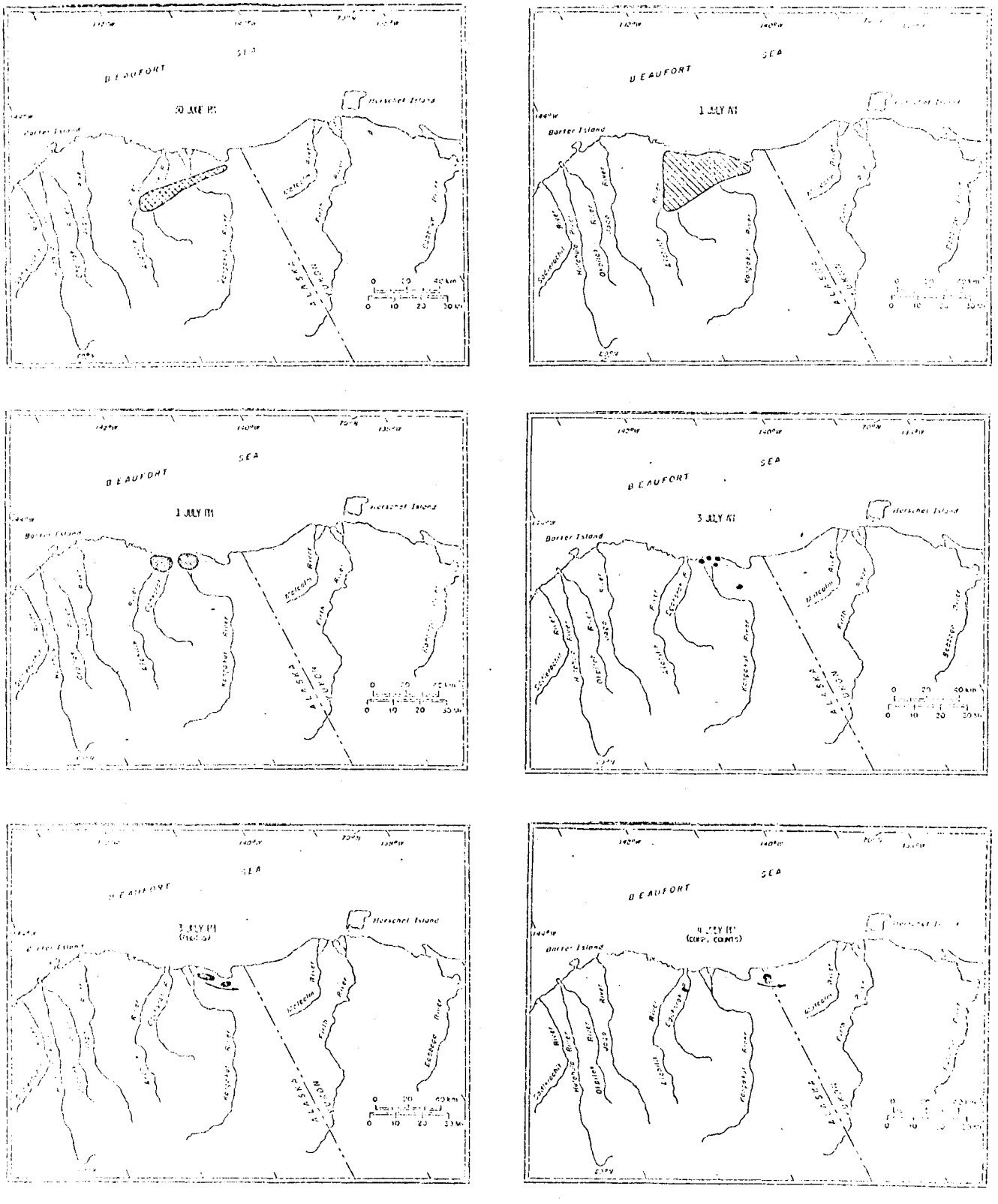

Fig. 2. Progressive aggregation of the Porcupine Herd in northeastern Alaska, 1979.

Table 1. Aerial photo counts of caribou post-calving aggregations taken in 1979.

Group	Number of Caribou		
	ADF&G Count	Yukon Game Branch Count	
	Total	Total	Calves
Turner River	53,420	59,288	13,573
Kongakut	29,087	30,830	7,672
Firth River/Komakuk	8,277	9,437	26
Crow River		6,138	0

Enumerating caribou on the ADF&G photographs presented several problems. Previous workers used stereo pairs of photos to facilitate counting caribou and, especially, to insure that rocks, brush, bare ground, etc., were not counted as caribou (Bente and Roseneau 1978). In most of the ADF&G photos, caribou moved sufficiently between consecutive frames that they did not appear in 3 dimension in the stereo viewer. Fortunately, these photos were taken on flat ground with few rocks or bushes, and caribou images were of adequate quality so that little difficulty was experienced in differentiating caribou from background features. Therefore, caribou were counted from single frames, using a 10x hand lens.

Caribou movement created another, more serious, problem, however. The large aggregations required up to eight parallel transects with the photo-plane, and the elapsed time between passes over a point on the ground with adjacent, overlapping transects was often 5 minutes or more. Transects were oriented along the axis of animal movement, and there was little problem accounting for caribou at end-lap lines (between frames within a transect). However, there was often considerable movement diagonally across side-lap lines (between frames in adjacent transects). In the Firth River group caribou were sufficiently dispersed so that individual caribou were often recognizable from one transect to the next, and such movements could be accounted for. In contrast, caribou in the large groups in Alaska were very densely and evenly distributed, and individuals were impossible to distinguish from one transect to the next. Lateral movement between transects in these groups was considerable, and we could determine no objective way to assess it. In all cases, movement appeared to be from a transect toward the previously flown (and counted) transect. Thus, caribou moving across side-lap lines were not counted on any photo. It also proved difficult to fly exactly parallel transects over relatively featureless terrain. Although side-lap was about 50 percent at the beginning of each transect, some flight lines diverged so that there was no side-lap at the far end; hence, some caribou between transects were not photographed. The net result of these various complications was that the number of caribou counted from photos was less than the actual number present.

These problems were unforeseen and, in retrospect, were largely unavoidable given the existing field conditions. Previous photo-censuses in Alaska did not involve individual groups as large or as mobile as those we encountered. The reliability of the technique used by the YGB was not affected by group movement, as there were no gaps in coverage or discontinuities between frames. However, the oblique photographs undoubtedly excluded a number of calves hidden behind adults. Calves and adults were recorded separately when

counting these photos so the calf percentage determined from the photos could be compared to the same value obtained from ground counts as a means of estimating how many calves were missed in the photos.

Table 1 gives the counts, by group, for both ADF&G and YGB photographs. The YGB totals were consistently higher than the ADF&G counts, indicating that underestimates were greater with the transect technique. The very low numbers of calves in the Firth River and Crow River bands should indicate very little error in the YGB counts of those groups. Caribou movement was largely accounted for in the ADF&G photos of the Firth River band. However, the ADF&G count was substantially lower than the YGB count. Since those photographs were taken on different days, it is possible that the group was actually larger when YGB photographed it.

Possible observer bias in counting the ADF&G photos was assessed by having two people make separate counts of the Firth River band. Results appear in Table 2. Observer I did not have a tally register available for his first count, and most of his error (relative to Observer II and to his own recounts) appears attributable to being unable to keep mental records of large numbers. Observer I's second count was much closer to Observer II's total. The tally register began sticking on frames 259 and 260 during Observer I's second count, and a final (3rd) recount of those frames gave a total very close to the counts of Observer II. Observer II's recount gave a total very similar to his first count, but this resulted from adjusting individual frame counts both up and down. In summary, use of a tally register in proper working order greatly reduced disagreement between observers. However, neither observer was able to consistently enumerate the same number of caribou for any frame.

Since YGB employed a counting technique which left a permanent record to compare with the original photo, it was possible for each technician to check his own work. Disagreements between separate counters could also be checked against the original. Thus, the total number of caribou in each frame was determined with a high degree of accuracy. However, designation of adult and calf caribou remained subjective in many cases. Guide marks for placing an acetate grid overlay in exactly the same position for each recount on the ADF&G photos would allow more direct cross checking between observers. Marking images on separate prints would lead to the same degree of accuracy as obtained in the YGB photos.

Peripheral Area Counts

Only one caribou was sighted during transect surveys, but the transects had to be discontinued in order to conduct the ground composition counts. After those counts were completed, caribou from the large aggregations dispersed rapidly into

Table 2. Replicate counts of caribou on photographs taken in 1979 by ADF&G at the Firth River/Komakuk area.

	Observer I			Observer II	
	1	2[1]	3[2]	1	2[1]
230	114	113		130	127
241	272			285	
242	419			403	
243	60			52	
249	987	863		893	
250	623	572		562	
251	252	231		183	237
252	381	388		357	380
258	256			244	
259	1322	1021	1085	1102	1086
260	1354	1204	1355	1447	1355
261	385	367		409	368
266	7			5	
267	95			95	
268	597	554		556	
269	1245	1181		1086	1151
270	92	92		112	99
278	20			21	
279	127	131		110	138
280	25			28	
281	33			26	
283	100			96	
284	76			70	
	8842	8080[3]	8295[3]	8272	8277[3]

[1] All frames on which counts totalled over 100 and differed by more than 5 percent between observers were recounted by both observers.

[2] A malfunctioning tally register required a third count of two frames.

[3] Total incorporates changes into original count.

the area that remained to be covered by transects, and it thus became impossible to complete the transect surveys. However, pre-census reconnaissance revealed that essentially no caribou remained within that area prior to dispersal of the large groups. No caribou were observed in any of the quadrat samples. In addition, cursory aerial surveys by YGB of only the most favorable caribou habitat south of Old Crow Flats located only three caribou. Thus, while the total number of caribou absent from photographs could not be calculated, that number was certainly negligible compared to the 105,693 caribou counted on the photos.

Composition Counts

After the photo runs on the evening of 3 July, the two large aggregations in Alaska first dispersed and then regrouped into a single band near Demarcation Bay on 4 July (Fig. 2). Composition counts were conducted by ADF&G as this dense aggregation crossed the Clarence River into Canada. Although the crossing occurred in two distinct movements, these were not comparable to the photographed groups. Therefore, all composition counts at Clarence River were lumped and considered representative of the aggregate total for the two groups photographed in Alaska on 3 July. Composition counts of the Firth River/Komakuk band were conducted by YGB on 5 July. Both photos and composition counts of the Crow River band were completed by YGB on 7 July. Table 3 shows results of the composition counts. Time interval counts used to assess within-group variability in composition appear in Appendix I, but will not be discussed in this report.

Herd Size and Composition

The YGB photo counts were consistently higher and presumably more accurate than the ADF&G counts. However, calves which were unseen in the oblique photos remain a problem. Assuming that calves and adults (yearlings included) were accurately distinguished in the photos and that the ground count classification for each group was representative of that group, the number of calves missed in the photo counts can be calculated and a new total number of caribou estimated for each group. Table 4 shows the results of these calculations and gives the hypothetical composition of each group and of the whole population. The percentages of cows, calves, yearlings, and bulls for each group in Table 4 are the same as in the ground composition counts (Table 3). The new estimate of 113,872 caribou in Table 4 is the total from YGB photographs (Table 1) plus 8,179 calves calculated to be unseen on the photos.

The yearling:cow ratio in the herd (Table 4) was 17:100. Yearling:cow ratios can vary from year to year, depending on both initial production of calves and on their survival to

Table 3. Composition counts of caribou post-calving aggregations taken in 1979.

Group	Cows		Calves		Yearlings		Bulls		Total
	No.	%	No.	%	No.	%	No.	%	
Turner R. & Kongakut	10,474	54.7	5,726	29.9	1,345	7.0	1,616	8.4	19,155
Firth River/ Komakuk	24	2.5	7	0.7	136	14.4	775	82.3	9,437
Crow River	29	0.9	4	0.1	284	8.8	2,902	90.2	6,138

Table 4. Calculated composition and size of caribou post-calving aggregations in 1979.

Group	Cows	Calves	Yearlings	Bulls	Total
Turner R. & Kongakut	53,721	29,377	6,887	8,265	98,250
Firth River/ Komakuk	245	66	1,365	7,802	9,478
Crow River	55	6	540	5,543	6,144
Totals	54,021	29,449	8,792	21,610	113,872

yearling age. There is no reliable means of assessing the accuracy of this 1979 yearling:cow ratio. However, unless calf mortality was unusually high, calf:cow ratios observed in summer (67:100) and fall (62:100) 1978 (Whitten and Cameron 1980) suggest a higher yearling:cow ratio than that reported here.

The bull:cow ratio recorded in summer 1979 was 40:100. Past estimates from fall composition counts (assumed to represent the entire herd) were 57:100 (LeResche 1975) and 78:100 (Bente and Roseneau 1978, Davis 1978). Whitten and Cameron (1980) reported bull:cow ratios of 31:100 and 32:100 in midsummer and fall 1978, respectively. However, they cautioned that biased estimates of herd composition are likely from small samples or from geographic isolates of the herd. Even in fall, when bulls and cows are more randomly distributed within groups, sex ratios from different groups can be extremely variable. Nevertheless, bull:cow ratios in unexploited or lightly hunted caribou herds are usually about 60-70:100 (Kelsall 1968, Skoog 1968). If a bull:cow ratio of 60:100 actually existed in 1979, and if herd composition reported in Table 4 is correct, then an additional 10,803 bulls were not observed during our census.

As stated earlier, search of peripheral areas yielded a negligible number of caribou outside photo groups. The consensus of researchers conducting peripheral area surveys and pre-census reconnaissance was that, while the presence of some additional caribou was possible, it was highly unlikely that thousands of caribou were unobserved. Therefore, if the number of caribou counted on the photos plus unobserved calves is the approximate number of caribou in the Porcupine Herd, composition based on ground counts (Tables 3 and 4) is either incorrect or indicates an unusually low proportion of bulls in the herd. Previous workers have commented on the nonrandom mixing of bulls and yearlings in post-calving aggregations and the related difficulty of obtaining representative composition data (LeResche 1975, Bente and Roseneau 1978). Therefore, we consider it most likely that the composition counts were inaccurate.

In summary, there were at least 105,693 caribou in the Porcupine Herd in midsummer 1979. This is based on a count of caribou present on aerial photographs. There may have been as many as 124,675 caribou if the minimum count is adjusted to match the expected sex/age composition of the herd. However, other data suggest that 124,675 caribou is too high. We believe that a reasonable total is 110,000 animals. This is based on the minimum count (with no corrections) plus an estimate of the calves overlooked on the photographs and a limited number of caribou missed in the peripheral area surveys. The estimated total of 110,000 caribou probably contains roughly 85,000 adults older than calves. This total is higher than the 1977 and 1972 estimates

for the herd. Even the minimum 1979 population based on caribou observed on photographs is as high as or higher than previous extrapolations. However, the broad confidence intervals associated with previous estimates make it impossible to determine if the herd has grown. The 1979 results indicate that there are approximately 45-50,000 cows in the herd, roughly the same as in the 1972 estimate and higher than in the 1977 count. Based on known problems associated with midsummer composition counts, these figures cannot be used to clearly indicate a trend. However, they do indicate that a possible decline in the cow base of the herd as suggested by Bente and Roseneau (1978) and Davis (1978) has probably not occurred.

Recommendations

Future censuses of this herd should be accomplished using the modified APDCE technique (Davis et al. 1979). However, a census attempt should not proceed until post-calving groups reach maximum aggregation. In years when no major aggregation occurs and a large proportion of the herd remains in peripheral areas, large confidence intervals of a population estimate detract from the value of a census. Conversely, with photo planes readily available and/or through use of the oblique photography technique, it costs little extra to conduct a census during every year when a large aggregation does occur. This is particularly true because the equivalent of pre-census reconnaissance and composition counts are conducted annually. Of course, such frequent counts may not be deemed necessary. Both vertical and oblique photography should be employed whenever possible to utilize the advantages of each technique and to provide duplicate photos if one camera should fail.

Sex/age composition should be assessed in conjunction with all censuses to provide a crosscheck on the results. At the present time, however, knowledge of the adult sex ratios in the Porcupine Herd appears inadequate and crosschecking is therefore tentative. Assessment of the adult sex ratio should therefore become a primary research goal. Results of past surveys have not been adjusted for nonrandom distribution of sexes, nor have subsample results been appropriately weighted according to the proportion of the herd they may represent.

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LITERATURE CITED

Bente, P. J., and D. G. Roseneau. 1978. An aerial photo-estimate of the 1977 Porcupine Caribou Herd population. Renewable Resources Consulting Services Ltd., Fairbanks, AK. 84pp.

Calef, G. W., and G. M. Lortie. 1973. Observations of the Porcupine Caribou Herd, 1972. Interim Report No. 3. Environmental Protection Board, Winnepeg, Manitoba. 127pp.

Davis, J. L. 1978. Sex and age composition of the Porcupine Caribou Herd. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest. Proj. Final Rept. W-17-9 and W-17-10, Job 3.23R. Juneau. 23pp.

_____, P. Valkenburg, and S. J. Harbo, Jr. 1979. Refinement of the aerial photo-direct count-extrapolation caribou census technique. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest. Proj. Final Rept. W-17-11, Job 3.25R. Juneau. 23pp.

Hemming, J. E. 1972. Techniques for aerial photo censusing of caribou. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest. Proj. Prog. Rept. W-17-2 and W-17-3. Juneau. 4pp.

Kelsall, J. P. 1968. The migratory barren-ground caribou of Canada. Dept. Indian Affairs, Northern Div., Can. Wildl. Serv., Ottawa, Ontario. 340pp.

LeResche, R. E. 1975. Porcupine Caribou Herd studies. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest. Prog. Rept. W-17-5. Juneau. 21pp.

Roseneau, D. G., and P. M. Stern. 1974. Distribution and movements of the Porcupine Caribou Herd in northeastern Alaska, 1972. Arctic Gas Biol. Rept. Ser. Vol. 7. 208pp.

_____, _____, and C. Warbelow. 1974. Distribution and movements of the Porcupine Caribou Herd in northeastern Alaska and the Yukon Territory. *In* K. H., McCourt, and L. P. Horstman, eds. Studies of large mammal populations in northern Alaska, Yukon and Northwest Territories, 1973. Arctic Gas Biol. Rept. Ser. Vol. 22, Chapt. 4. 186pp.

_____, J. A. Curatolo, and G. D. Moore. 1975. The distribution and movements of the Porcupine Caribou Herd in northeastern Alaska and the Yukon Territory, 1974. *In* L. P. Horstman, and K. H. McCourt, eds. Studies of large mammals along the Mackenzie Valley gas pipeline from Alaska to British Columbia. Arctic Gas Biol. Rept. Ser. Vol. 32, Chapt. 3. 104pp.

_____, and _____. 1976. The distribution and movements of the Porcupine Caribou Herd in northeastern Alaska and the Yukon Territory, 1975. *In* R. D. Jakimchuk, ed. Studies of mammals along the proposed Mackenzie Valley gas pipeline route, 1975. Arctic Gas Biol. Rept. Ser. Vol. 36, Chapt. 1. 82pp.

Russell, J. 1977. Progress report of Porcupine Caribou Herd research October through December 1977. Yukon Wildlife Branch, Unpubl. Rept. 20pp.

Skoog, R. O. 1968. Ecology of the caribou (*Rangifer tarandus granti*) in Alaska. Univ. Calif., Berkeley, Ph.D. Thesis. 699pp.

Surrendi, D. C., and E. A. DeBock. 1976. Seasonal distribution, population status and behavior of the Porcupine Caribou Herd. Can. Wildl. Serv., Mackenzie Valley Pipeline Investigation, Ottawa. 144pp.

Whitten, K. R., and R. D. Cameron. 1980. Composition and harvest of the Porcupine Caribou Herd. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest. Prog. Rept. W-17-11, Job 3.23R. Juneau. 8pp.

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APPENDIX I. Time interval subsamples of composition counts in 1979 Porcupine Herd post-calving aggregations.

Location	Observer	Interval	Cow	Calf	Yrlg	Bull
Komakuk	R. Farnell	3 min	0	0	14	33
			2	0	10	141
			7	3	10	70
			1	0	16	117
Crow River	W. Nukon	3 min.	0	0	5	94
			0	0	15	145
			0	0	9	159
			0	0	0	162
			2	0	19	55
			4	0	1	45
			0	0	2	114
Crow River	R. Farnell	3 min	0	0	18	74
			0	0	16	51
			0	0	33	129
			0	0	1	33
			0	0	1	27
			0	0	4	14
			0	0	2	15
Crow River	W. Nukon	3 min	0	0	5	35
			1	0	2	53
			0	0	5	87
			0	0	2	49
			0	0	4	37
			0	0	7	85
			0	0	3	64
Crow River	R. Farnell	3 min	0	0	3	61
			0	0	10	40
			0	0	0	1
Crow River	W. Nukon	3 min	1	0	7	78
			0	0	3	86
			1	0	2	49
			0	0	7	55
			0	0	4	57
			0	0	5	40
			0	0	1	97
			0	0	3	102
			0	0	1	69
			0	0	2	79
			0	0	3	147
			1	0	5	35
			1	0	6	29
			0	0	2	10

APPENDIX I (continued)

Location	Observer	Interval	Cow	Calf	Yrlg	Bull
Crow River	--	3 min	3	1	17	119
			11	2	12	123
			4	0	28	51
			1	0	9	46
Komakuk	R. Farnell	1 min	0	0	9	42
			1	0	7	25
			0	0	9	48
			0	0	6	39
			0	0	4	27
			5	0	6	45
			3	1	4	53
			1	0	18	45
			2	2	7	36
			2	1	6	23
			0	0	10	31
Clarence River	J. Davis and P. Valkenburg	10 min	365	129	38	99
			412	174	42	100
			313	187	24	51
			110	75	21	15
			123	81	21	22
			56	45	18	2
			334	235	20	19
			326	235	61	30
			155	106	34	9
Clarence River	D. Roby and W. Smith	90 min	1002	392	131	93
Clarence River	J. Wright	10 min	40	4	11	25
			85	12	31	22
			158	78	7	7
			172	93	5	14
			73	41	5	4
			504	291	12	16
			285	153	17	20
			442	211	31	47
			213	108	18	16
			198	102	5	21
Clarence River	K. Whitten	10 min	24	10	22	15
			103	92	5	6
			143	117	9	8
			215	193	39	43
			400	384	91	84
			29	26	6	2
			7	8	5	1
			117	93	29	24
			391	293	99	137

APPENDIX I (continued)

Location	Observer	Interval	Cow	Calf	Yrlg	Bull
Clarence River	P. Valkenburg and J. Davis	10 min	180	33	25	25
			111	42	15	15
			106	55	10	8
			150	70	18	29
			316	227	7	32
Clarence River	D. Roby and M. Jacobson	10 min	88	28	13	7
			359	166	31	48
Clarence River	J. Wright	10 min	53	16	4	6
			230	45	38	29
			92	37	5	23
			225	44	17	23
			303	152	25	40
			19	8	3	1
			156	89	17	10
			136	90	20	37
			80	31	9	3
Clarence River	K. Whitten and R. Cameron	10 min	120	65	43	68
			84	57	42	34
			82	34	15	48
			121	48	15	40
			133	43	11	21
			196	154	53	60
			133	102	20	10
			87	66	17	13
			119	50	15	34

APPENDIX II. Harvest of the Porcupine Caribou Herd in Alaska

SUMMARY

Nonunit hunters reported transporting 59 caribou from Game Management Units 25 and 26C in the 1979-80 season. Distribution of caribou was such that local village residents hunting near their homes took very few caribou and the overall harvest in Alaska was probably just over 100.

BACKGROUND

From statehood to 1976 there was no closed season, no bag limit, and no close monitoring of harvest from the Porcupine Herd in Alaska. Seasons and bag limits were imposed in 1976, and hunters transporting caribou out of Game Management Unit (GMU) 26C or those portions of GMU 25 within the range of the Porcupine Herd have since been required to file harvest report cards, thus providing a means of assessing the nonlocal or sport harvest of the herd. Total harvest from the U.S. and Canada has generally been less than 5,000 caribou, with half, or less, of the take occurring in Alaska. Within Alaska the majority of the harvest has normally been by local subsistence hunters.

OBJECTIVE

To assess the annual harvest of Porcupine Herd caribou within Alaska.

PROCEDURES

Harvest and hunting pressure in Alaska were estimated through the return of "Arctic Caribou Harvest Report Cards," which were required for the transport of caribou outside GMU 25 and GMU 26C. Local harvest by Kaktovik and Arctic Village residents was estimated by Arctic National Wildlife Range (ANWR) personnel through village contacts and interviews. Harvest by other villages in the Porcupine Herd range was not recorded.

RESULTS

The 1979-80 open season for Porcupine Herd caribou in Alaska was 1 July-31 March, with a bag limit of five caribou, no more than two of which could be transported from GMU 25 or 26C. "Arctic Caribou Hunter Report Cards" were required for such transport; 791 permits were issued, presumably to "out-of-unit" hunters. Of 284 individuals returning tickets, 186 did not hunt, 45 hunted but were unsuccessful, 42 were successful, 3 returned blank cards, and 8 actually hunted outside of the applicable units. Fifty-seven people hunted in GMU 25; of 29 successful hunters, 16 transported 1 caribou

each and 13 took 2 each for a total kill of 42. Twenty-seven people reported hunting in GMU 26C; 12 were successful, with 7 taking 1 caribou each and 5 taking 2 each for a total harvest of 17 caribou. In addition, two people reported hunting unsuccessfully for Porcupine Herd caribou but did not state where they hunted, and one hunter killed a caribou in the ANWR but did not indicate in which unit he hunted.

Residents of GMU 25 or 26C were not required to report harvest of caribou which they consumed within those units. Porcupine Herd caribou were not available near Arctic Village in 1979-80, and the entire village harvest was only three caribou. Kaktovik also experienced a relatively poor hunting year and their take was fewer than 100 and probably less than 50 caribou.

RECOMMENDATIONS

No changes in Porcupine Herd season or bag limit are suggested. The international Porcupine Caribou Technical Committee has stressed the need for more precise data on harvest. The Subsistence Section has agreed to assist in gathering local harvest data in Alaska. Furthermore, harvest tickets will be required for all caribou hunters in the Porcupine Herd range during the 1980-81 season. This should also allow more direct assessment of local harvest.