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DEPARTMENT OF FISH AND GAME

DIVISION OF WILDLIFE CONSERVATION

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MEMORANDUM

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Roy Nowlin – Management Coordinator, Region III, Alaska Dept. of Fish and Game

CC: Porcupine Caribou Technical Committee Members

FROM: Jason Caikoski – Assistant Area Biologist, Northeast Alaska, Alaska Dept. of Fish and Game
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DATE: 2 February, 2010

SUBJECT: Porcupine Caribou Herd—Fall 2009 Composition Survey

Overview

The Alaska Dept. of Fish and Game (ADFG), the Department of Environment, Government of Yukon (YDOE), and the U.S. Fish and Wildlife Service- Arctic National Wildlife Refuge (USFWS) conducted a composition survey of the Porcupine Caribou Herd (PCH) on their winter range during 14-16 October, 2009. The PCH was distributed over a large geographic area extending from the foothills in the upper Coleen River drainage, Alaska, south-east, to the Ogilvie Mountains, Yukon Territories. For the portion of PCH in Alaska, caribou were radiotracked by an ADFG technician from a chartered Cessna 182 operated by Tundra Air. Caribou were classified by ADF&G biologist Jason Caikoski from a chartered Robinson 44 helicopter operated by Quicksilver Air. For the portion of PCH in Yukon, caribou were radiotracked by USFWS biologist Dave Payer from a Cessna 206 operated by the USFWS. Caribou were classified by YDOE technician Martin Kienzler and biologist Dorothy Cooley from a chartered Bell 206 Jet Ranger helicopter operated by Kluane Helicopters.

Sampling Methods

We surveyed near peak of rut to take advantage of the peak of mixing of bulls, cows, and calf caribou. Peak of rut was estimated as the date 228 days (gestation period) prior to the median calving date of the PCH, 2002-2009. The survey occurred from 229-231 days prior to the median calving date. Caribou groups were located by radiotracking collared caribou (both bulls and cows) from fixed wing aircraft. Group location and the number of radiocollars in each group was determined by fixed wing aircraft and

relayed to the helicopter immediately prior to the arrival of the helicopter to each caribou group. We defined a group as caribou that were lumped together and spatially separated or distinguishable from neighboring caribou or caribou groups. We attempted to locate most radiocollared caribou and sample across the full spatial expanse of the herd. However, funding and logistical constraints limited sampling to about 1/3 of the 111 radiocollared caribou (95 cows and 16 bulls).

The number of caribou classified per caribou group was weighted based on the number of radiocollars present in each group. Approximately 200 random caribou were classified by helicopter per radiocollar per caribou group. If caribou groups contained less than 200 caribou per radiocollar, all or most of the caribou in those groups were classified. Caribou were classified as bull, cow, or calf. Group samples were recorded independently. We did not count or estimate the total number of caribou in each group.

Results

We located 34 radiocollared caribou and identified 30 caribou groups containing 1-3 radiocollars per group (Figure 1). Most caribou groups contained 1 radiocollared caribou (n=27), 2 groups contained 2 radiocollared caribou, and one contained three. Four of the 30 groups were located by radiocollared bulls and the remaining groups were located by radiocollared cows. In addition to the 34 radiocollared caribou used for sampling, we located (to the regional scale, i.e. Alaska or Yukon) 35 radiocollared caribou (31 cows and 4 bulls) that were not sampled. The number of individuals classified per group ranged from 19-616 caribou and varied based on the number of radiocollared caribou present per group and the total number of caribou available for classification in each group. The number of individuals classified per radiocollar ranged from 19-349 caribou and averaged 201 caribou. A total of 6,897 caribou were classified of which 6,000 were adults.

Substantial heterogeneity in the calf:cow and bull:cow ratios were observed at both the group and the regional scales (i.e., Alaska vs. Yukon). The calf:cow and bull:cow ratios varied substantially by group, ranging from 7 to 60 calves per 100 cows and 20 to 86 bulls per 100 cows, and the distributions were skewed to high values, particularly for bulls (Table 1 and Figures 2a and b). Chi-square tests indicated that these group differences are highly significant (i.e., P's < 0.001) among all groups and among groups within Alaska and the Yukon. The calf:cow ratio for all caribou sampled in Alaska (16 calves per 100 cows) was significantly less than that for caribou sampled in Yukon (24 calves per 100 cows; $\chi^2 = 35.0$, df $= 1$, $P < 0.001$) and the proportion of adult caribou that were bulls was significantly greater for caribou sampled in Alaska (0.34 or 51 bulls per 100 cows) than for caribou sampled in Yukon (0.26 or 35 bulls per 100 cows; $\chi^2 = 46.6$, df $= 1$, $P < 0.001$).

Composition also varied depending on whether the caribou sampled were associated with a radiocollared bull or cow. The calf:cow ratio for caribou sampled with radiocollared bulls (25 calves per 100 cows) was significantly greater than that for caribou sampled with radiocollared cows (21 calves per 100 cows; $\chi^2 = 3.8$, df $= 1$, $P = 0.05$) and the proportion of adult caribou that were bulls was significantly greater for caribou sampled with radiocollared bulls (0.34 or 52 bulls per 100 cows) than for caribou sampled with radiocollared cows (0.28 or 39 bulls per 100 cows; $\chi^2 = 10.5$, df $= 1$, $P = 0.001$).

Pooling the group data led to a population calf:cow ratio of 21 calves per 100 cows and a bull:cow ratio of 40 bulls per 100 cows. As discussed below, we have determined that both of these ratios were biased

somewhat low. These sources of bias also lead to underestimating the variance associated with these ratio estimates; therefore, we did not report standard errors (e.g., calculated using a cluster sampling estimator).

Discussion

The population composition estimates are biased due to a combination of spatial heterogeneity in composition, the manner in which the radiocollars were used to sample caribou, and the demographic distribution of the radiocollars. Strictly speaking, an unbiased sample for composition analysis requires that the sample of radiocollars reflect the spatial distribution and demographics of the herd. In practice, these conditions cannot be not fully achieved; however, they can be approximated thus reducing the magnitude of bias. For this survey, the effort to sample across the spatial distribution of the herd and the use of radiocollared bulls in addition to radiocollared cows to locate caribou helped mitigate potential bias and allows us to take an educated guess as to its magnitude.

Because the proportion of sampled collars that were on bulls (0.12) was far less than the proportion of bulls in the population, bull dominated groups were underrepresented in this sample. Therefore, we expect that the true bull:cow ratio was greater than the pooled average (i.e., 40 bulls per 100 cows). Had we deployed more bull radiocollars and sampled proportionally more groups using these radiocollars, we would have obtained a ratio closer to that end member. Using the mean ratios for groups identified with radiocollared bulls and cows as end members in mixing relationships, we determined ranges for the population composition ratios. We consider a point estimate in the range of 42 to 46 bulls per 100 cows more consistent with sampling the radiocollars proportional to reasonable bounds for the population bull:cow ratio. Similarly, we expect the calf:cow population ratio to be greater than the pooled average (21 calves per 100 cows) due to undersampling bull dominated groups leading to a range for the point estimate of 22 to 24 calves per 100 cows. This relatively narrow range is primarily due to the similarity of the calf:cow ratio for groups identified by bull and cow radiocollars.

We expect additional bias due to disproportionate sampling at the regional scale to be relatively small. The distribution of satellite collars deployed on adult cows, (n = 11) suggests that radiocollared cows were sampled approximately in proportion to the spatial distribution of cows at the regional scale (36% percent of satellite collared cows were in Alaska and 38% of the sampled radiocollared cows were in Alaska). The larger bull:cow ratio in Alaska compared to Yukon indicates that bulls were distributed somewhat differently than cows. Unfortunately, the distribution of caribou (bull or cow) could not be ascertained directly from the distribution of radiocollars because only about half (62%) of the radiocollars were located. However, having sampled approximately in proportion to the distribution of cows combined with accounting for undersampling bull dominated groups likely renders any regional scale bias a second order effect. It is important to emphasize that these ranges are not confidence intervals but instead an attempt to quantify the magnitude of bias associated with the point estimates. In addition, the ranges themselves are not well constrained due to uncertainty in the mean composition ratios for the bull collared groups and to a lesser degree in the spatial distribution of the herd.

Recommendation

Estimating population composition of large caribou herds that exhibit substantial spatial and temporal variability in composition is a difficult problem that requires further research to resolve. The difficulties

identified above are not restricted to this survey. Substantial spatial and intergroup variability in composition ratios was also observed for the Teshekpuk and Central Arctic herds in 2009 (ADFG files). Similar to the data observed for the PCH, composition varied between caribou sampled using radiocollared bulls and those identified using radiocollared cows for the Teshekpuk herd in 2009 (ADFG files). A comprehensive evaluation of this topic is recommended with particular attention given to developing strategies for identifying and mitigating these and other sources of sample bias (e.g., those related to age and reproductive status) to the extent necessary for sound management. Specific recommendations for future surveys of the PCH that can be provided at this time are: 1) consider deploying radiocollars on bulls and cows in close proportion to the expected bull:cow ratio; 2) consider locating all radiocollared caribou at the time of the survey to better estimate the distribution of the herd; and, 3) sample radiocollared caribou proportional to the distribution and demographics of the herd.

Funding
Operational survey funding was provided by YDOE. ADF&G, USWFS, and YDOE personnel conducted the survey and ADF&G provided data analyses and reporting.

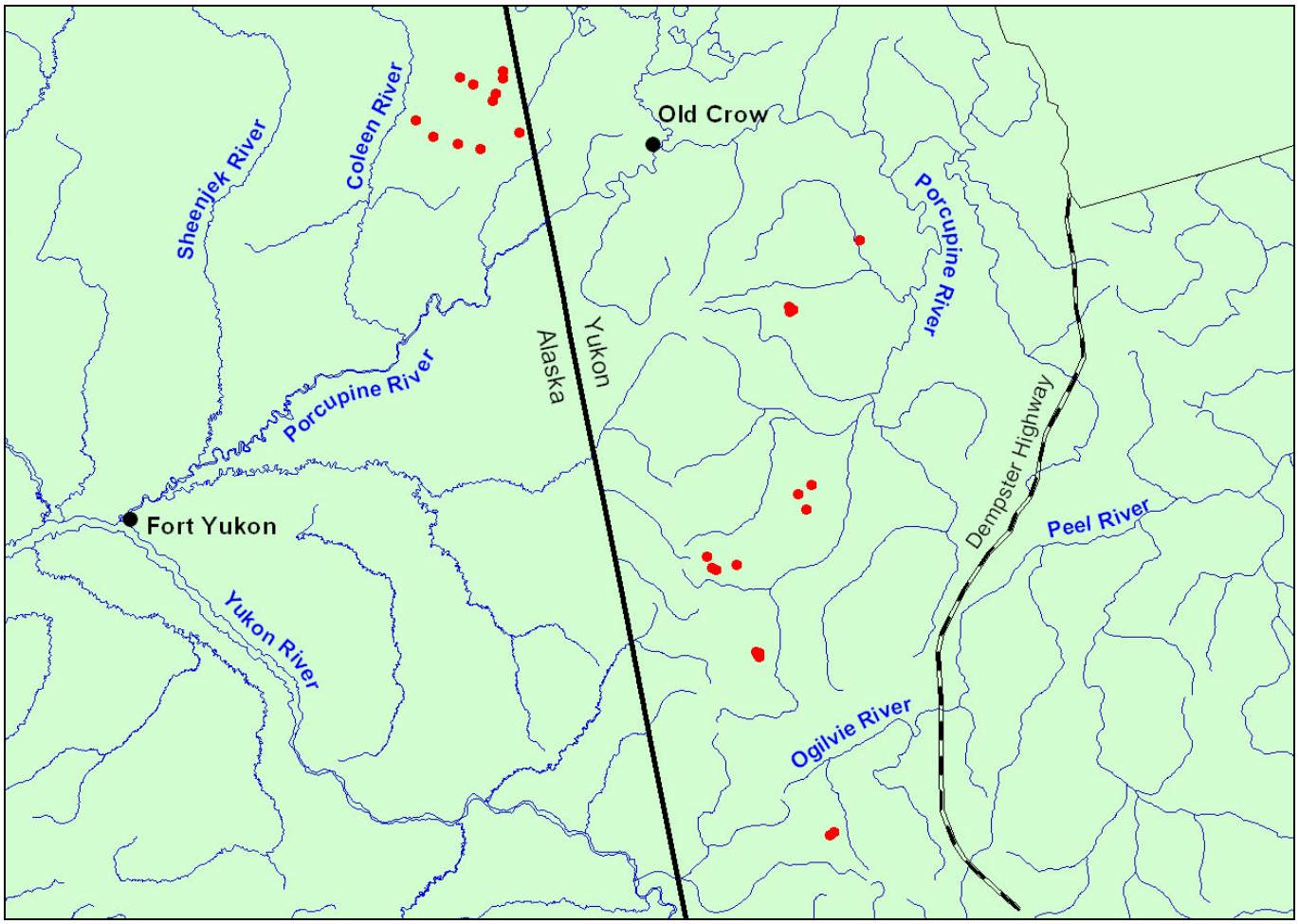


Figure 1. Locations of caribou groups sampled for herd composition, October 2009.

Table 1. Sex and age composition of Porcupine Caribou groups (*n*=30) sampled by helicopter during 14-16 October, 2009 in Alaska and Canada.

Group #	Location[a]	Latitude	Longitude	Number of radiocollars[b]	# sampled[d]	# of cows	# of calves	# of bulls	Bull:cow	Calf:cow
1	YU	65.7180	-139.9407	2	616	379	104	133	0.35	0.27
2	YU	65.7122	-139.9184	1	284	180	37	67	0.37	0.21
3	YU	65.7031	-139.9246	1	132	87	17	28	0.32	0.20
4	YU	65.7102	-139.9351	1	349	233	47	69	0.30	0.20
5	YU	65.6955	-139.9279	1	264	187	39	38	0.20	0.21
6	YU	66.2646	-139.1379	1[c]	237	160	32	45	0.28	0.20
7	YU	66.2422	-139.2725	1	53	39	6	8	0.21	0.15
8	YU	66.1808	-139.2400	1	77	58	6	13	0.22	0.10
9	YU	66.7000	139.3000	1	19	12	1	6	0.50	0.08
10	YU	66.8962	-138.9541	1	234	140	56	38	0.27	0.40
11	YU	66.8916	-138.9816	1	348	218	56	74	0.34	0.26
12	YU	66.9117	-138.9822	1	245	139	36	70	0.50	0.26
13	YU	67.0880	-138.2060	2	466	322	53	91	0.28	0.17
14	YU	66.0918	-140.1914	1[c]	42	20	12	10	0.50	0.60
15	YU	66.0461	-140.1617	1	133	77	36	20	0.26	0.47
16	YU	66.0363	-140.1312	1	301	203	49	49	0.24	0.24
17	YU	66.0389	-139.9467	1	140	94	24	22	0.23	0.26
18	YU	65.0205	-139.6128	1	173	93	9	71	0.76	0.10
19	YU	65.0101	-139.6497	1[c]	256	119	35	102	0.86	0.29
20	AK	67.8472	-142.0428	1[c]	233	136	28	69	0.51	0.21
21	AK	67.7790	-141.8987	1	218	140	16	62	0.44	0.11
22	AK	67.7358	-141.6837	1	132	72	8	52	0.72	0.11
23	AK	67.7020	-141.4908	1	232	147	20	65	0.44	0.14
24	AK	67.7357	-141.0932	1	253	165	16	72	0.44	0.10
25	AK	67.8677	-141.2855	1	219	129	19	71	0.55	0.15
26	AK	67.8902	-141.2412	1	202	128	9	65	0.51	0.07
27	AK	67.9402	-141.1470	1	212	113	41	58	0.51	0.36
28	AK	67.9652	-141.1313	1	199	131	11	57	0.44	0.08
29	AK	67.9377	-141.4345	3	504	282	34	188	0.67	0.12
30	AK	67.9722	-141.5490	1	124	68	40	16	0.24	0.59
Sum					6897	4271	897	1729		
Range[e]									42-46	22-24

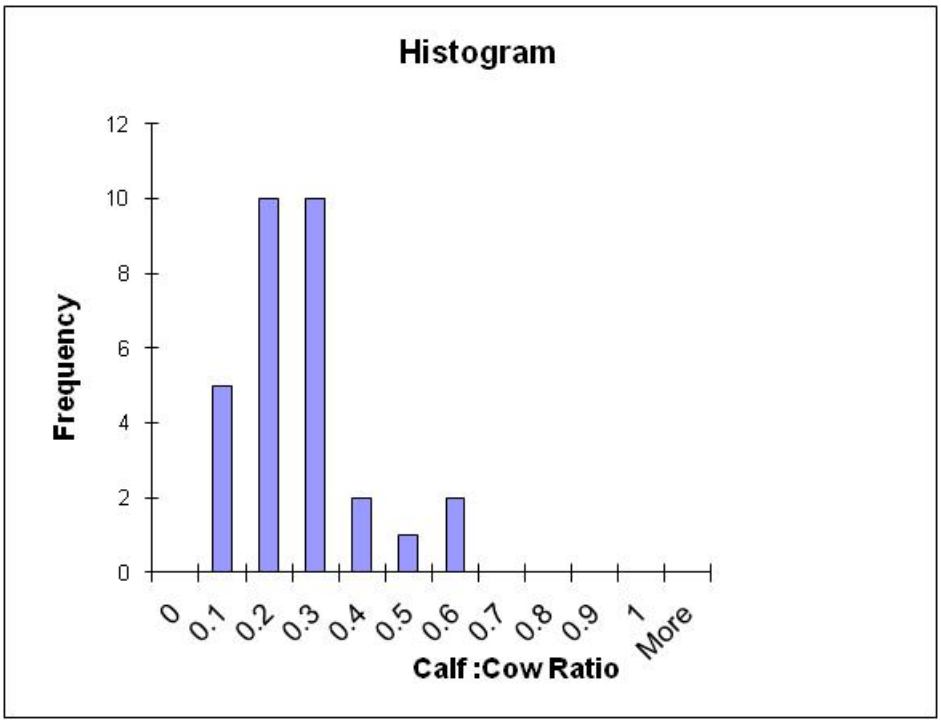
[a]YU = Yukon Territory, Canada AK = Alaska, USA

[b]Number of radiocollars present per group

[c]Indicates radiocollared bull, all others are radiocollared cows

[d] Number of caribou classified per group, total group size unknown

[e] Recommended range for the point estimate as described in the discussion. The point estimate ranges are not confidence intervals. Pooling the group data yields a bull:cow ratio of 40 bulls per 100 cows and a calf:cow ratio of 21 calves per 100 cows.



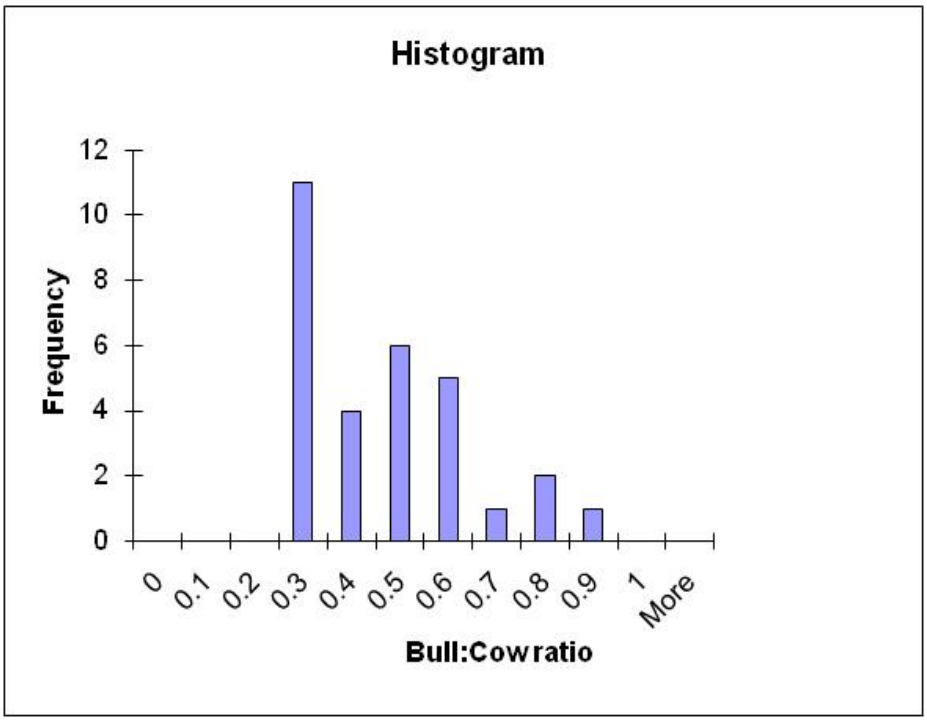


Figure 2a and 2b –Histograms of calf:cow and bull:cow ratios from caribou groups sampled for age and sex composition, October 2009.