Groups versus individuals in the determination of caribou distribution

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Abstract: Studies of caribou *(Rangifer tarandus)* habitat selection based on group analyses have led to erroneous conclusions. Convenient designations such as «male-» or «female-dominated» group encompass a wide array of possible sizes and compositions which change continuously and erratically. Whenever individuals of at particular sex/age class can occur in more than one group type, and/or whenever groups within a type vary in size, an analysis based on groups alone is fallacious. Data must be based on individual caribou for most, if not all, determinations of distribution.

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Introduction

Caribou *(Rangifer tarandus)* are social animals and usually occur in groups. Over short time periods, at least, caribou groups are cohesive units. Behavior of individuals within a group tends to be uniform and synchronous, and groups often respond to various stimuli as a unit. Also, many groups are relatively homogeneous, e.g., predominantly adult males or predominantly cow/calf pairs. Thus, it appears reasonable to analyze caribou behavior or distribution patterns by studying caribou groups.

There is another, more practical reason for recording data on groups rather than individual caribou. It is easier to assign an entire group some general category of composition, activity, or location than it is to record the same data for each individual in the group. This is particularly true when groups are large or far away, when the observer is flying rapidly past the group in an aircraft, and/or when the terrain does not permit full view of all individuals in a group.

However, certain characteristics of caribou groups render them inappropriate for describing the distribution of a population. In this paper we demonstrate how failure to consider variations in group size and composition has led to erroneous conclusions on differential habitat use by male and female caribou.

Caribou groups

Lent (1965) and Bergerud (1974) concluded that caribou groups are loose social units characterized by temporary and tenuous social bonds. Recent radio-telemetry studies in Alaska and the Yukon Territory indicate that caribou captured together frequently change groups and seldom reassociate with each other (Valkenburg *et al.*, 1983; D. Russell and R. Farnell, pers. comm.) Miller (1974) and Miller *et al.* (1975), on the other hand, concluded that small groups, or «winter bands», are the basic units of caribou social organization, and that affinity to these bands persists for many years, perhaps for life; caribou groups observed during the rest of the year are either aggregations or fragments of these winter bands. Thus, the concept of winter bands is not entirely inconsistent with the general conclusion that caribou groups are dynamic.

Virtually all studies of caribou social organization confirm that group size and composition change seasonally and that, within any one season, groups vary considerably in both size and composition. Large groups generally behave differently from small groups, and male-dominated groups behave differently from female-dominated groups. Moreover, convenient categories of group type may sometimes be inappropriate. For example, the distribution of males cannot be determined by examining only the distribution of male-dominated groups because males occure in female-dominated groups as well.

Differential habitat use and reactions to disturbance by male and female caribou

Recently, Carruthers *et al.* (1984) and Curatolo (1985) concluded that female and calf caribou in the Central Arctic region of Alaska avoid riparian habitats. These authors further suggested that one would therefore expect to find few cows and calves along the Trans-Alaska Pipeline System (TAPS) where it is closely associated with the Sagavanirktok River. Such conclusions conflict with our earlier findings that the proportion of cows and calves among caribou along the Dalton Highway (TAPS haul road) was lower than that among caribou observed along all major rivers and the coastline within the range of the Central Arctic Herd (CAH) (Cameron *et al.*, 1979; Cameron and Whitten, 1980; Whitten and Cameron, 1983). If the conclusions of Carruthers *et al.* (1984) and Curatolo (1985) are valid, we should have seen relatively few cows and calves anywhere along our survey route, except possibly along the coast. This was decidedly not the case. How then could our conclusions be so different?

Analyses based on groups

Both Carruthers *et al.* (1984) and Curatolo (1985) assumed that the distribution of male and female caribou could be determined by sampling the distribution of male- and female-dominated groups. Both used similar categories of group type. Curatolo (1985) defined a cow group as comprising more than 70% cow/calf pairs and a bull group as more than 70% bulls. Carruthers *et al.* (1984) defined a female group as one in which more than 67% of the caribou were classified, and more than 67% of the classified adults were female; in a male group, more than 67% were classified, and of those, more than 67% were males. Under either definition, some bulls could occur in cow groups, and vice versa. In fact, by the Carruthers *et al.* (1984) definition, a male or female group could theoretically contain mostly members of the opposite sex (e.g., 0.67 x 0.67 = minimum of 44% males in a male group). Differences in group size were not considered in either study, and all groups were weighted equally in determining habitat use. Both studies demonstrated that a significantly higher proportion of male *groups* than of female *groups* was found in riparian habitat.

Riparian habitats covered 9% of the regional aerial strip transects used by Carruthers *et al.* (1984) to determine caribou distribution. More than 9% of the male groups were in riparian habitat during all seasons, and less than 9% of the female groups used riparian areas during most seasons (Table 1). Furthermore, female groups were, on average, farther than expected from riparian habitats (based on mean distance available) while male groups were usually closer. Thus, Carruthers *et al.* (1984) concluded that females avoided areas within and near riparian habitats. Curatolo (1985) reached the same conclusion based on the observation that 37% of bull groups were in riparian habitat during summer, versus only 19% of the cow/calf groups.

These results can be extrapolated to the population as a whole only if individual male and female caribou were distributed similarly to male and female groups. The problems outlined above suggest that such an assumption is, at best, tenuous. Curatolo (1985) reported only summarized results, but Carruthers *et al.* (1984) presented sufficient data to test this assumption.

Analyses based on individuals

Reanalysis of the data presented by Carruthers *et al.* (1984) indicates that the distribution of *individual* male and female caribou was quite different from the distribution of male- and female-dominated *groups*. On average, female groups were larger than male groups. Assuming that group sizes were similar among habitats, caribou in female groups would have outnumbered those in male groups in riparian areas during much of the year, even though a smaller proportion of female groups than of male groups was observed in riparian habitat (Table 1).

Table 1. Distribution of caribou in male and female groups relative to riparian habitat, Central Arctic Slope, Alaska.[a]

	Mean group size in all habitats		Occurrence in riparian habitat[b]					
			No. of groups		% of total groups seen		No. of individuals[c]	
Season	male[d]	female[d]	male	female	male	female	male	female
Winter	7.6	6.7	22	7	33	31	167	47
Spring	5.8	3.8	3	6	14	8	17	23
Calving	3.6	10.2	84	23	26	4	302	234
Postcalving	5.7	40.6	43	25	33	30	245	1015
August dispersal	1.6	8.0	74	21	25	6	118	168
Pre-rut	3.2	6.5	21	10	17	5	67	65
Rut	1.4	6.1	14	19	10	10	20	116

[a] Based on data presented by Carruthers *et al.* (1984).
[b] 9% riparian habitat available.
[c] (number of groups) X (mean group size). Does not take into account possible differences in group size between riparian and nonriparian habitats.
[d] Group type.

Carruthers *et al.* (1984) reported numbers and composition of individual caribou for only 1 year of their 3-year study. In 1983, they compared caribou observed during regional aerial surveys with caribou observed along a transect flown directly over TAPS, but unfortunately reported data on caribou within 2 km of riparian habitat rather than in riparian habitat only. An analysis based on the distribution of individuals shows that caribou consistently preferred riparian areas, both along TAPS and in the surrounding region (Table 2). Use of areas in or near riparian habitats by all caribou and by calves was high relative to availability of riparian habitat. The higher proportions of individual caribou in or near riparian habitats (Table 2), than of caribou groups in riparian habitats (Table 1), could indicate that groups in riparian habitats were larger, or that many groups occurred close to (<2 km), if not within, the riparian zone. Either case negates the conclusion that one would expect to see few cows and calves along a major river.

Most striking, however, is that percentage calves among caribou along TAPS was consistently lower than in the surrounding region (Table 2). Within or near riparian habitat, calves were less abundant along TAPS except during calving. In nonriparian habitats, calves were less abundant along TAPS except during August dispersal and pre-rut.

In summary, there is no clear evidence that calves (and, by inference, their mothers) consistently used riparian habitats differently than did other caribou. All caribou preferred riparian habitats, and cow/calf pairs avoided all habitats along TAPS. This reanalysis of the findings of Carruthers *et al.* (1984) corroborates our own conclusions (based on data from individual caribou) that cow and calf caribou are underrepresented along TAPS, but not in similar habitats elsewhere. Local disturbance by traffic and construction activity is likely the major cause of this cow/calf avoidance (Cameron *et al.*, 1979; Cameron and Whitten, 1980; Whitten and Cameron, 1983).

Curatolo (1985) reported the distribution of individual CAH caribou in demonstrating that calf percentages in study sites along the Kuparuk River were only ca. 40% of those in nonriparian study sites farther west near Oliktok Point. Petroleum development was considered to have influenced distribution in both areas equally. Therefore, Curatolo (1985) concluded that the relative scarcity of cows and calves along the Kuparuk River was due to their natural avoidance of riparian areas, a conclusion supported elsewhere in his paper by the analysis of caribou *group* distribution. Curatolo failed to note, however, that the area near the Kuparuk River had been disturbed for at least 10 years

Table 2. Distribution of individual caribou relative to habitat type along the Trans-Alaska Pipeline (TAPS) and in the surrounding region, Central Arctic Slope, Alaska[a].

	% occurrence within 2 km of riparian habitat				% calves							
	All caribou		Calves		All habitats		Within 2 km of riparian		Nonriparian		No. of caribou	
Season	TAPS[b]	REG[c]	TAPS	REG	TAPS	REG	TAPS	REG	TAPS	REG	TAPS	REG
Winter	48	42	70	32	3	25	5	20	2	29	287	583
Spring	99	33	100	48	17	17	17	25	0	13	156	326
Calving	57	20	89	6	9	26	14	8	2	30	208	745
Postcalving	87	19	95	21	10	14	11	16	4	14	560	299
August dispersal	93	16	67	11	8	26	5	17	33	28	80	874
Pre-rut	74	18	56	13	15	23	11	17	25	25	122	651
Rut	42	28	44	23	7	19	7	18	7	19	359	1376

[a] Based on data presented by Carruthers *et al.* (1984).
[b] 34% riparian habitat available
[c] 9% riparian habitat available

before his study began in 1982, whereas the Oliktok Road in the nonriparian area had been built just that year. Furthermore, calf percentages in the Kuparuk River area declined from levels similar to regional estimates in 1978 to ca. 40% of regional estimates by 1980 (Cameron *et al.* 1981). Thus, we believe disturbance to be the primary cause of cow/calf underrepresentation along the Kuparuk River, rather than any natural avoidance of riparian areas.

The cause hypothesized by both Carruthers *et al.* (1984) and Curatolo (1985) for cow/calf avoidance of riparian habitats in general (i.e., instinctive avoidance of predator-concealing habitat) is not operative in the range of the CAH. While predators may ambush caribou in tall riparian willow (*Salix* spp.) stands in the ranges of many herds (Curatolo, 1975; Bergerud, 1974; Boertje, 1981), both predators and tall willows are scarce on the summer range of the CAH. Riparian areas are more often characterized by terraces with cushion tundra vegetation consisting mainly of *Dryas*, legumes, forbs, and low (<0.5 m) willows. Tussock or wet sedge tundra often extends to the very edge of a watercourse, and islands in braided streams often have typical tundra vegetation. Lack of predators and a mosaic of habitat types, including both foraging areas and vegetation-free areas for insect relief, may in fact explain the *preference* for riparian areas noted here for all caribou, including cows and calves.

Conclusions

Data based on groups are not appropriate for describing population distribution or habitat preference. Our reanalysis of the data of Carruthers *et al.* (1984) demonstrates that individual bulls and/or cow/calf pairs were not distributed similarly to male- and female-dominated groups. Extrapolations based on treatment of groups as equivalent units yielded erroneous results. By inference, Curatolo's (1985) conclusions based on similar methodology are also suspect.

Few researchers would make the mistake of treating unequal areas as equivalent sample units. For example, no one would compare caribou density in two areas by determining the number of caribou per linear km using 1-km wide transects in one area and 2-km wide transects in the other. Yet this is precisely the sort of error made when caribou distribution is described by weighting all groups equally.

Caribou groups vary in size and composition, and members of the same sex/age class usually occur in more than one group type. Therefore, an analysis based on groups alone will not be representative of a population. Individual caribou must serve as the basis for most, if not all, studies of distribution.

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References

Bergerud, A.T. 1974. The role of the environment in the aggregation, movement, and disturbance behaviour of caribou. — *In: Geist, V. and Walther, F. (eds.). The Behaviour of Ungulates and its Relation to Management. Vol. 2. IUCN New Series No. 24:552-584.*

Boertje, R.D. 1981. Nutritional ecology of the Denali Caribou Herd. — *M.S. Thesis, Univeristy of Alaska, Fairbanks. 294 p.*

Cameron, R.D., and **Whitten, K.R.** 1980. Influence of the Trans-Alaska Pipeline corridor on the local distribution of caribou. — *In: Reimers, E., Gaare, E. and Skjenneberg, S. (eds.). Proceedings of the Second International Reindeer/Caribou Symposium, Røros, Norway, 1979. Trondheim: Direktoratet for vilt og ferskvannsfisk. 475-484.*

Cameron, R.D., Whitten, K.R., and **Smith, W.T.** 1981. Distribution and movements of caribou in relation to the Kuparuk Development Area. — *Third Interim Report to ARCO, EXXON and SOHIO. Alaska Department of Fish and Game, Fairbanks. 37 p. (Available from Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701, U.S.A.)*

Cameron, R.D, Whitten, K.R., Smith, W.T., and **Roby, D.D.** 1979. Caribou distribution and group composition associated with construction of the Trans-Alaska Pipeline. — *Canadian Field-Naturalist 93(2):155-162.*

Carruthers, D.R., Jakimchuk, R.D., and **Ferguson, S.H.** 1984. The relationship between the Central Arctic caribou herd and the Trans-Alaska Pipeline. — *Renewable Resources Consulting Services Ltd., Report to Alyeska Pipeline Service Company. 154 p. (Avaliable form Alyeska Pipeline Service Company, 1835 South Bragaw Street, Anchorage, Alaska 99512, U.S.A.).*

Curatolo, J.A. 1975. Factors influencing, local movements and behavior of barren-ground caribou *(Rangifer tarandus granti).* — *M.S. Thesis, University of Alaska, Fairbanks. 146 p.*

Curatolo, J.E. 1985. Sexual segregation and habitat use by the Central Arctic Caribou Herd during summer. — *In: Meredith, T.C. and Martell, A.M. (eds.). Proceedings of the Second North American Caribou Workshop. McGill Subarctic Research Paper No. 40. McGill Universtiy, Montreal. 193-198.*

Lent, P.C. 1965. Rutting behaviour in a barren-ground caribou population. — *Animal Behaviour 13:259-264.*

Miller, F.L. 1974. Biology of the Kaminuriak population of barren-ground caribou. Part 2: Dentition as an indicator of sex and age; composition and socialization of the population. — *Canadian Wildlife Service Report Series No. 31. 88 p.*

Miller, F.L., Anderka, F.W., Vithayasia, C., and **McClure, R.L.** 1975. Distribution, movements and socialitzation of barren-ground carbou radio-tracked on their calving and post-calving areas. — *In: Luick, J.R., Lent, P.C., Klein, D.R. and White, R.G. (eds.). Proceedings of the First International Reindeer/Caribou Symposium, University of Alaska, Fairbanks, 1972. Biological Papers of the University of Alaska, Special Report No. 1:423-435.*

Valkenburg, P., Davis, J.L. and **Boertje, R.D.** 1983. Social organization and seasonal range fidelity of Alaska's Western Arctic Caribou Herd — preliminary findings. — *Acta Zoologica Fennica 175:125-126.*

Whitten, K.R., and **Cameron, R.D.** 1980. Nutrient dynamics of caribou forage on Alaska's Arctic Slope. — *In: Reimers, E., Gaare, E. and Skjenneberg, S. (eds.). Proceedings of the Second International Reindeer/Caribou Symposium, Røros, Norway, 1979. Trondheim: Direktoratet for vilt og ferskvannsfisk. 159-166.*

Whitten, K.R. and **Cameron, R. D.** 1983. Movements of collared caribou in relation to petroleum development on the Arctic Slope of Alaska. — *Canadian Field Naturalist 97(2):143-146.*