

Disturbance and the Delta Caribou Herd

by James L. Davis, Patrick Valkenburg,
and Rodney D. Boertje

Alaska Dep. of Fish and Game, 1300 College Road,
Fairbanks, AK 99701

1. Abstract

The Delta Caribou Herd has been exposed to more disturbance than any other Alaskan caribou herd. Frequent bombing, strafing, artillery firing, and low-level overflights by military and civil aircraft have occurred on traditional calving areas and adjacent ranges. Calving success was apparently not adversely affected by exposure to dense wildfire smoke during calving in 1979 and 1983 and selection of a 3-year-old burn for calving in 1982. Despite these disturbances and others, the herd has increased at an annual rate of 19–22% since 1976 and is now larger than ever recorded. We infer from these and other observations that the Delta Caribou Herd is reasonably adaptable to a wide range of “significant disturbances.”

2. Résumé

La harde de caribous du Delta a été plus souvent dérangée que toute autre harde de caribous de l'Alaska. Des bombardements, du mitraillage au sol, des tirs d'artillerie et des survols à basse altitude par des avions militaires et civils ont souvent eu lieu dans les aires de mise bas habituelles et les domaines adjacents. Il semble que le succès de la mise bas n'ait pas été affecté par l'exposition à la fumée épaisse pendant la mise bas en 1979 et en 1983 ni par le choix d'un brûlis de trois ans pour la mise bas en 1982. Malgré ces perturbations et autres dérangements, la harde s'est accrue à un taux annuel de 19 à 22 % depuis 1976 et est maintenant plus importante que jamais. À partir de ces constatations et d'autres observations, nous concluons que la harde de caribous du Delta est passablement adaptable à une vaste gamme de «perturbations importantes».

3. Introduction

Since 1950 the Delta Caribou (*Rangifer tarandus granti*) Herd (DCH) has been exposed to more man-made auditory and visual disturbance than any other Alaskan caribou herd. Continuing concern about the possible detrimental effects of disturbance on caribou (Luick *et al.* 1975) warrants an analysis of DCH population dynamics and behaviour in relation to disturbance.

Like several other Alaskan caribou herds, the DCH's size has varied considerably since 1950, including a sharp decline in the early 1970s. Disturbance from military and civilian activities in the area may have contributed to this decline (ADF&G 1976). Consequently,

when we began investigating factors limiting the DCH in the mid-1970s, we considered the possible role of man-made disturbance.

We considered man-made disturbance in three broad categories: (1) sensory stimuli, (2) physical alteration of habitat, and (3) the presence of physical structures. Sources of sensory stimuli included artillery, wildfire, aircraft, all-terrain vehicles, and mining and hunting activities. Alterations of habitat included the effects of burning, mining, and littering with military debris (such as targets, shell cases, missiles, and parachutes). Physical structures included developments such as roads, pipelines, mines, airfields, railroads, communities, and industrial complexes.

In evaluating the effects of disturbance on the DCH, we discuss correlations between herd productivity, population trend, and disturbance, and consider herd behaviour in relation to disturbance, with particular emphasis on the calving period. Though caribou workers hold diverse views about caribou behaviour and the effects of disturbance, most concur that caribou are most sensitive during calving (Bergerud 1978, Klein 1980, Cameron 1983).

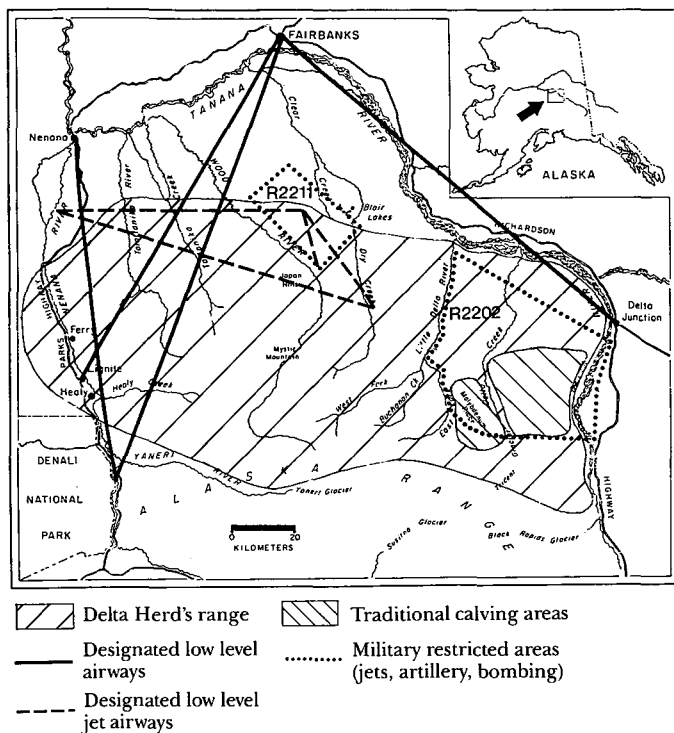
4. Study area

Skoog (1968) originally described the range of the DCH. Based on subsequent study, Hemming (1971) modified Skoog's description and described the physical environment. Little change has been warranted since Hemming's revision.

The DCH currently ranges over about 9600 km² on the north slopes of the Alaska Mountain Range between the Nenana River on the west and the Delta River on the east (Fig. 1). The area lies approximately 110 km south of Fairbanks. The Alaska Range rises abruptly from its foothills and consists of rugged, glaciated ridges, 1830–2740 m in elevation interspersed with glacier-capped mountains exceeding 3660 m. The northern foothills of the Alaska Range are flat-topped ridges, 610–1370 m in elevation, separated by rolling tussock tundra, muskegs, and spruce-covered lowlands. North of the foothills lies the predominantly spruce-covered Tanana Flats. The entire area is drained by the Tanana River.

The study area is largely snow free from May until October. Annual temperature range is approximately 29°C to –51°C. Annual precipitation averages about 30 cm; snow accumulation averages 0–50 cm and rarely exceeds 80 cm. Ground vegetation in the foothills and

Figure 1
Range of the Delta Caribou Herd and location of major sources of potential disturbances



mountains is frequently exposed during winter because of strong winds. Although the herd is widely distributed from the mountains to the flats during winter, foothills appear most used.

As calving time approaches, cows and many short yearlings move into the upper portion of the Little Delta River and Delta Creek to the traditional core calving areas (Fig. 1), which have been used since at least the 1950s. Most calves are born on tussock tundra, but many others are born in the low shrub- and sparse spruce-dominated areas. Most bulls and some short yearlings remain widely scattered throughout the herd's entire range during calving.

5. Methods

Pre-1974 caribou data were obtained from files and unpublished reports of the Alaska Department of Fish and Game (ADF&G) and from personal communication with ADF&G biologists M. Buchholtz and L. Jennings.

Most post-1974 caribou data were obtained from our field observations. Since 1972, estimates of herd size have been obtained from aerial photo-direct count-extrapolation (APDCE) censuses (Gasaway *et al.* 1983). Methods for estimating caribou natality, productivity, recruitment, harvest, survival, and sex/age composition were previously described or referenced (Davis *et al.* 1980, Davis *et al.* 1983, Gasaway *et al.* 1983, and Valkenburg *et al.* 1983).

Estimates of amounts and chronology of artillery firing, aircraft flights, bombing, and gunnery are based on records provided by the US Army and the Federal Aviation Administration. Fire data are from the authors' observations and from US Bureau of Land Management and US Army records.

6. Results

6.1. Population size

Davis *et al.* (1983) summarized the DCH's demography from 1950 through 1981. Between the mid-1930s and 1954, the DCH apparently numbered less than 1000. There were an estimated 1500 caribou by 1957 and 5000 by 1963 (excluding calves). Estimates from 1963 through 1970 were consistently about 5000. Estimates from 1963 through 1972 included about 1000 caribou in what is now considered the Macomb Caribou Herd (Davis 1980), but before 1972 were considered as part of the Delta Caribou Herd.

In 1973, an APDCE census of the DCH estimated 2198–2409 caribou. Subsequent APDCE census estimates were 3700–3961 in 1979; 4194–4448 in 1980; 4180–5320 in 1981; and 6500–7500 in 1982. Ranges in the population estimates are not confidence intervals, but are separate extrapolations by two "independent" methods (Davis *et al.* 1982).

Davis and Preston (1980) speculated that the population declined between 1973 and 1975, but began increasing in 1976, based on composition and productivity data.

6.2. Natality/survival

No production/survival data were collected before 1969. Estimates of natality and survival of calves exist for most years since 1969 (Table 1) and natural mortality rates of cohorts older than calves have been determined since 1980.

From monitoring radio-collared caribou and from population modelling, Davis and Valkenburg (1983) concluded that natural mortality in the DCH was quite low between 1976 and 1982, and that natural mortality of males was considerably greater than that of females. They concluded that between 1976 and 1982 the annual natural mortality of caribou older than calves ranged from a low of 3% to a high of 4–8%.

6.3. Sensory disturbance

Figure 1 depicts several areas where sensory disturbances occur with the greatest intensity and frequency. Military restricted areas R-2202 and R-2211 are sites of regular bombing, strafing, and artillery firing. Low-flying military aircraft are present almost daily and ground manoeuvres occur intermittently. Actual quantification of use of these areas since 1950 is beyond the scope of this discussion. However, available information supports our contention that these areas have been sources of substantial sensory disturbance to the DCH for several decades, particularly during calving.

According to Federal Aviation Administration staff and military range control personnel, R-2211 averaged about 32 operations (i.e. 32 aircraft days) per week during 1982–83. That means an average of more than six aircraft used the area every day of the year, excluding weekends. Many of these operations included use of the associated low level jet airways (Fig. 1). Aircraft using the restricted areas include A-10s, Cessna 02s, large and small helicopters, and several types of jet fighter/bomber.

The range control officer for R-2202 commented that almost every day, excluding weekends, aircraft fired 20 mm cannons and/or dropped bombs in R-2202. He also commented that the area had been in continuous use

since about 1950. On about 20 May 1982, however, when we discovered the unusually close proximity of calving caribou to the impact area and notified the military, they suspended activities until after calving. Similarly, in 1983, the army resource specialist responsible for the area requested and received a suspension of activities during May. The target area in R-2202 is located near the centre of the restricted area along Delta Creek (Fig. 1); therefore, the primary disturbance is auditory in most years.

Before 1976, the two long-axis boundaries of R-2211 extended to R-2202. Military aircraft frequently fly in this area and other portions of the DCH's range, using civil visual flight rules (VFR). In addition, designated low level airways (Fig. 1) are frequently used by many civil aircraft. Most of these flights are several hundred metres or more above ground level.

Several hundred civil aircraft frequent the herd's range each year. Over 700 light single engine aircraft are located in the greater Fairbanks area alone. Many of these aircraft are "STOL" aircraft which can and do land throughout much of the herd's range. Clearly, the DCH's range is frequented by large numbers of military and civil aircraft.

Because of recent concern over the possible effects of aircraft disturbance on caribou (Klein 1973, Calef *et al.* 1976, Miller and Gunn 1979), we measured the response of the DCH to overflights during 1979 through 1983 (Valkenburg and Davis, this workshop). Either Delta caribou have become habituated to aircraft disturbance or they never learned to fear aircraft to the same degree as some other caribou herds.

Snow machines and all-terrain vehicles have varied in abundance in the DCH's range (Valkenburg and Davis, this workshop). Hunters have annually spent thousands of man-days hunting caribou from the late 1960s through 1973 and from 1980 to the present. Even during 1974–79 when caribou hunting was not permitted, many hundreds of people hunted moose, sheep, and bears in the DCH's range.

The DCH's past exposure to loud noises from thunderstorms may be a factor in their present apparent habituation to sensory disturbances. Thunderstorm activity is relatively high in the Alaska Range in the summertime, as evidenced by the electrocution of 53 caribou in the DCH in June 1972 (Shaw and Neiland 1973). Some mining has occurred in the area annually since 1950, and a few people have resided in the DCH's range since the 1950s.

In aggregate, we believe that the DCH has been exposed to more sensory disturbance, on a mean annual basis, than any other Alaskan caribou herd.

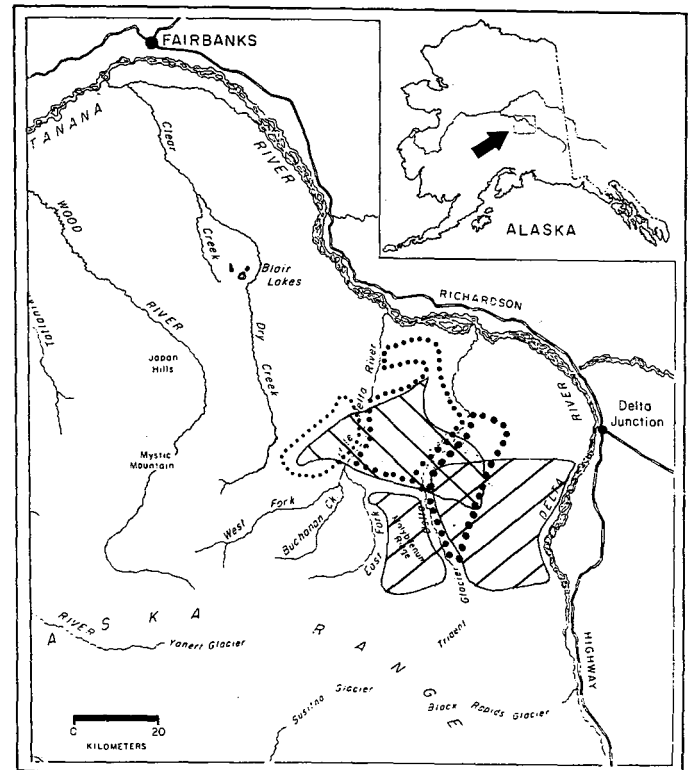
6.4. Habitat alteration






Although fire records are incomplete, it appears that few fires covering more than 40 ha have occurred in the DCH's range in the past 30 years. Three major fires are delineated in Figure 2. In June 1971, a lightning strike resulted in a 7082 ha burn about 10–20 km northwest of the traditional core calving areas. In 1979 a fire was burning prior to the onset of calving and smoke was prevalent on the traditional core calving area throughout the calving and post-calving period. The exact cause of this 46 540 ha fire is unknown but it started in an artillery/

bombing impact area (we suspect that military exercises started the fire). This fire burned to the northern boundary of the traditional core calving areas (few unburned inclusions occurred). A 20 235 ha fire caused by artillery started on 9 May 1983 and burned until August: this fire burned a major portion of the traditional eastern core calving area (leaving many small unburned inclusions). Smoke was prevalent throughout the calving and post-calving periods.

Figure 2

Major wildfires adjacent to the Delta Caribou Herd's traditional core calving areas and 1982 core calving area



- | | | | |
|---|--------------------------------|---|-----------------------|
|  | Traditional core calving areas |  | Fire 1971 (7082 ha) |
|  | 1982 core calving area |  | Fire 1979 (46 540 ha) |
| | |  | Fire 1983 (20 235 ha) |

6.5. Physical structures

Few significant physical structures exist in the DCH's range. Perhaps 20–30 airstrips and approximately 30 dwellings are present. A few roads extend from the Nenana River on the west to the Totatlanika River, but vehicular traffic is limited. Interestingly, a major highway and railroad as well as a river valley exist near the DCH's range border to the west, and a major highway and river valley mark the existing eastern boundary. Although major crossings have occurred, it is unclear if these physical structures contribute to boundary demarcation. No physical structures coincide with northern and southern boundaries.

7. Discussion

Aggregate sensory disturbance within the range of the DCH has apparently been considerable for decades. This applies both to the entire range and to the traditional calving area. In spite of this, the DCH has continued use of its traditional calving area, and since 1976 has been one of the fastest-growing herds in Alaska. Mean annual growth has been 19–22% (Davis and Valkenburg 1983), and the present size of the herd is the largest in written history.

In view of the concern that has been given to wildfires and the welfare of caribou (Klein 1982), we believe several observations about the DCH are important. Although most concern about wildfires on caribou range centres on winter range rather than calving areas, it is unclear if this emphasis has been based on recognition of differing seasonal needs of caribou, or resulted from a *de facto* omission because most caribou calve on alpine or arctic tundra where wildfires are rare. Nonetheless, caribou calving areas are frequently considered “critical habitat” and the previous almost universal concern about detrimental impacts of wildfire has influenced some management decisions regarding calving habitat. For example, draft management plans for the DCH (ADF&G 1976) emphasize protection of calving grounds from fire. Also, many northern natives have stated to the authors that caribou will avoid areas where smoke is present.

Our observations of the DCH are inconsistent with the above concern about fires on or near calving areas. In 1982, the DCH was apparently precluded from calving in its traditional core areas because of persistent snow cover and instead used an alternate calving area roughly within the area burned in 1979 (Fig. 2), even though snow conditions were as favourable in unburned areas northeast, northwest, and west of the 1979 burn, where some calving occurs in most years. Calving in 1982 was quite successful, which suggests that caribou may have considerable flexibility in their habitat requirements (Table 1). Calving caribou were exposed to heavy wildfire smoke throughout calving in 1979 and 1983 with no apparent adverse effects on productivity or survival.

Considering productivity (Table 1) and population growth of the DCH in recent years, it is evident that existing physical structures are not limiting factors. Nor have we been able to correlate trends in herd growth and/or productivity with levels of disturbance. Davis *et al.* (1983) demonstrated an inverse relationship between herd performance (i.e. size and recruitment) and predation.

8. Summary and conclusions

In spite of the DCH's exposure to the highest levels of mean annual disturbance of any Alaskan caribou herd, the DCH has grown at an annual rate of 19–22% annually since 1976 and is one of the fastest growing herds in Alaska. Sensory disturbances have included almost daily bombing, strafing, artillery firing, and high levels of low-flying military and civil aircraft year round on traditional core calving areas and adjacent areas. Military aircraft and several hundred civil aircraft frequent the herd's entire range. Delta caribou were heavily exposed to wildfire smoke throughout calving in 1979 and 1983 with no apparent adverse effects on productivity and survival. Habitat disturbance included burning of an area adjacent

Table 1

Spring and fall calf:cow ratios in the Delta Caribou Herd, 1972–83

Year	Calves:100		Calves:100	
	cows, spring*	Sample size	cows, fall†	Sample size
1969	—	—	28	828
1970	—	—	34	896
1971	—	—	16	1139
1972	—	—	11	1184
1973	24	1124	10	1050
1974	4	1058	2	1141
1975	13	976	—	—
1976	56	1099	45	1055
1977	34	1224	42	1365
1978	24(71)‡	951(586)‡	39	725
1979	45	738	65	361
1980	43	1209	49	1369
1981	34	880	41	1553
1982	—(72)‡	—(259)‡	34	1691
1983	51(80)‡	1587(3982)‡	—	—

*Spring indicates sampling in mid-June almost 4 weeks after the peak of calving.

†Fall indicates sampling from October to early December.

‡Values in parentheses were obtained between 20 and 30 May near the peak of calving.

to the core calving area in 1979. In 1982 this burned area was selected for calving, presumably due to heavy snow accumulation on the traditional core calving area. Again we observed no adverse effects on productivity, indicating that caribou are more flexible in their selection of calving habitat than previously recognized. Major highways and railroads on or near the herd's boundaries also apparently are not important limiting factors.

In conclusion, high levels of sensory and habitat disturbance have been of minor importance as limiting factors. However, Davis *et al.* (1983) showed that harvest and predation by wolves were major limiting factors prior to 1976.

9. Acknowledgements

This work was funded by Federal Aid in Wildlife Restoration Project W-17-11. Many Alaska Department of Fish and Game personnel were helpful, including M. Buchholtz, L. Jennings, and D. Simpson. We thank the U.S. Army, particularly J. Kerns and K. Spiers, and the Federal Administration Agency for making their records available. We particularly thank our clerical staff for their special efforts necessitated by our hurried schedules. Special thanks to go to C. Nuckols and L. McManus. R.D. Cameron and W. Regelin reviewed the manuscript.

10. Literature cited

Alaska Department of Fish and Game. 1976. Delta caribou management plan. Pages 85–87 in Alaska Wildl. Manage. Plans—Interior Alaska. Draft Proposal. Juneau. 200 pp.

Bergerud, A.T. 1978. Caribou. Pages 83–101 in Schmidt, J.L.; Gilbert, D.L. eds. Big game of North America (ecology and management). Stackpole Books, Harrisburg, PA.

Calef, G.W.; DeBock, E.A.; Lortie, G.M. 1976. The reaction of barren-ground caribou to aircraft. Arctic 29(4):201–212.

- Cameron, R.D. 1983.** Issue: Caribou and petroleum development in Arctic Alaska. *Arctic* 36(3):227-231.
- Davis, J.L. 1980.** Status of *Rangifer* in the USA. Pages 793-796 in Reimers, E.; Gaare, E.; Skjennneberg, S. eds. Proc. 2nd Int. Reindeer/Caribou Symp., Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim.
- Davis, J.L.; Preston, D. 1980.** Calf mortality in the Delta Caribou Herd. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-11. Juneau. 29 pp.
- Davis, J.L.; Valkenburg, P. 1983.** Demography of the Delta Caribou Herd under varying rates of natural mortality and harvest by humans. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-1. Juneau. 50 pp.
- Davis, J.L.; Valkenburg, P.; Boertje, R.D. 1982.** Demography of the Delta Caribou Herd. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-21-2. Juneau. 24 pp.
- Davis, J.L.; Valkenburg, P.; Boertje, R.D. 1983.** Demography of the Delta Caribou Herd, 1954-1981. *Acta Zool. Fenn.* 175:135-137.
- Davis, J.L.; Valkenburg, P.; Reynolds, H.V. 1980.** Population dynamics of Alaska's Western Arctic caribou herd. Pages 595-604 in Reimers, E.; Gaare, E.; Skjennneberg, S. eds. Proc. 2nd Int. Reindeer/Caribou Symp., Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim.
- Gasaway, W.C.; Stephenson, R.O.; Davis, J.L.; Shepherd, P.E.K.; Burris, O.E. 1983.** Interrelationships of wolves, prey, and man in Interior Alaska. *Wildl. Monogr.* 84. 50 pp.
- Hemming, J.E. 1971.** The distribution and movement patterns of caribou in Alaska. Alaska Dep. Fish and Game. *Wildl. Tech. Bull.* No. 1. Juneau. 60 pp.
- Klein, D.R. 1973.** The reaction of some northern mammals to aircraft disturbance. Pages 377-383 in XI Int. Congr. Game Biol. Stockholm, Sweden.
- Klein, D.R. 1980.** Reaction of caribou and reindeer to obstructions—a reassessment. Pages 519-527 in Reimers, E.; Gaare, E.; Skjennneberg, S. eds. Proc. 2nd Int. Reindeer/Caribou Symp., Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim.
- Klein, D.R. 1982.** Fire, lichens, and caribou. *J. Range Manage.* 35(3):390-395.
- Luick, J.R.; Lent, P.C.; Klein, D.R.; White, R.G. (eds.). 1975.** Pages 3-32 in Proc. 1st Int. Reindeer/Caribou Symp. Biol. Pap. Univ. of Alaska. Spec. Rep. 1.
- Miller, F.L.; Gunn, A. 1979.** Responses of Peary caribou and muskoxen to turbo-helicopter harassment, Prince of Wales Island, Northwest Territories, 1976-77. *Can. Wildl. Serv. Occas. Pap. No. 40.* 90 pp.
- Shaw, G.E.; Neiland, K.A. 1973.** Electrocution of a caribou herd caused by lightning in central Alaska. *J. Wildl. Dis.* 9:311-313.
- Skoog, R.O. 1968.** Ecology of the caribou (*Rangifer tarandus granti*) in Alaska. Unpubl. Ph.D. Thesis, Univ. Calif. Berkeley. 699 pp.
- Valkenburg, P.; Boertje, R.D.; Davis, J.L. 1983.** Effects of darting and netting on caribou in Alaska. *J. Wildl. Manage.* 47(4):1233-1237.