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# DEMOGRAPHY OF THE DELTA CARIBOU HERD UNDER VARYING RATES OF NATURAL MORTALITY AND HARVEST BY HUMANS

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SUMMARY

This study contributed to better understanding of herd identity of caribou (Rangifer tarandus granti) inhabiting the north slopes of the Alaska Range between the Nenana River and the Delta River. Study results suggest 2 herds, the Delta and Yanert Herds, occupy the area. Prior to 1980 only the Delta Caribou Herd (DCH) was recognized.

Demography of the DCH was reviewed and/or documented through 1984. From the mid-1930's until 1954, only a few hundred caribou occupied the range of the DCH. The DCH increased rapidly following initiation of wolf (Canis lupus) control in 1954. The DCH numbered 1,500 by 1957 and 5,000 by 1963. Estimates of herd size from 1963 through 1970 were consistently about 5,000. These estimates exclude calves but include up to 1,000 caribou in the present range of the Macomb Caribou Herd.

Wolves were exploited heavily and continuously from 1954 through 1972 in the DCH's range. Hunting pressure on caribou increased in the early 1970's; the 1970-71 winter was of record severity; and wolves received greater legal protection in 1972. The DCH declined dramatically coincident to these events. The DCH declined to 2,198-2,409 by 1973 and hunting was eliminated. The DCH was not censused again until 1979 when 3,700-3,961 caribou were present. Based on calf survival data, it appears that the DCH declined through 1975 and began increasing rapidly in 1976 following the institution of wolf control. Subsequent

censuses showed the following population estimates: 4,194-4,448 in 1980; 4,180-5,320 in 1981; 6,298-6,792 in 1982; and 6,040-6,300 in 1983. These estimates do not include the caribou in the Yanert Caribou Herd (YCH). Estimates for the 2 herds combined are as follows: 1973, 2,804; 1979, 4,191; 1980, 4,478; 1981, 4,962; 1982, 7,335; 1983, 6,800-7,229; and 1984, 6,260.

The mean fall calf:100 cows ratio for 1971-74 was 9.7 (SD = 5.8); following wolf control in 1976-81, the comparable ratio increased to 47 (SD = 9.5). Following cessation of wolf control and coincident to increasing hunting pressure post-1981, caribou numbers have stabilized and calf survival appears to be declining. Harvest and predation appear to be the factors most responsible for determining population dynamics in the DCH and YCH.

The roles of weather, emigration/immigration, disturbance, disease, catastrophe, and other potential limiting factors were considered, but these factors did not adequately account for the observed population dynamics of the DCH. No habitat studies per se have been conducted. However, nutritional status indices such as rapid growth, early sexual maturity, high pregnancy rates, high natality and calf survival rates, and early parturition (i.e., shortened gestation period) have been monitored and indicate a high nutritional status. Further, range/energetic relationships of the DCH appear comparable to or better than those in the Denali Herd where Boertje (1981) concluded that nutritional status was high.

Results of this study have contributed to 7 publications listed in Appendix A.

Key words: Caribou, censusing, Delta Herd, demography, population dynamics, Rangifer, Yanert Herd.

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## BACKGROUND

### Herd Identity

Although caribou (Rangifer tarandus granti) have resided on the north slopes of the Alaska Mountain Range between the Canadian border and the Nenana River since at least 1918 (Murie 1935), their subpopulation (i.e., herd) identity has been poorly understood. Skoog (1968) and Hemming (1971) considered these caribou to be members of the Mentasta, Chisana, or Delta Caribou Herds (DCH). They agreed on the distribution and identity of the Chisana Herd but defined the ranges of the other 2 herds differently.

Skoog (1968) described the range of the DCH as, "...the north slopes of the Alaska Range from the upper Wood River on the west to the Robertson River on the east." Hemming (1971) described the DCH as ranging the north slopes of the Alaska Range between the Alaska Railroad on the west and the Richardson Highway on the east. Skoog included the caribou inhabiting the area between the Delta and Robertson Rivers as part of the DCH. Hemming, however, included these as part of the Mentasta Herd.

On the basis of more recent information, Davis and Neiland (1975) and Davis (1978, 1980) redefined herd identity of caribou occupying the area between the Nenana River and the Glenn Highway to include the Delta and Macomb Herds. From 1969, or earlier, to the present, caribou inhabiting the northern slopes of the Alaska Range west of Alaska Highway #1 (Tok Cutoff) and east of the Alaska Railroad have existed as 2 discrete groups. One group, the DCH, has consistently ranged west of the Delta River and east of the Alaska Railroad and calved near Trident and McGinnis Glaciers. This is consistent with Hemming's description of the DCH. The 2nd group, the Macomb Herd, has occupied the area east of the Delta River and west of Alaska Highway #1. The Macomb Herd has calved annually on the Macomb Plateau since at least the mid-1950's, according to the late Marvin Warbelow, a long-time pilot from Tanacross (L. Jennings, Alaska Department of Fish and Game [ADF&G], pers. commun.). ADF&G biologists have observed calving on the Macomb Plateau annually since 1969.

Skoog (1968) included the Macomb subpopulation as part of the DCH. Hemming (1971) considered the Macomb subpopulation as part of the Mentasta Herd although he reported that, "...local bush pilots have observed some calving activity on the Macomb Plateau east of the Johnson River."

Davis and Neiland (1975) believed that Macomb Plateau caribou composed a herd distinct from either the DCH or Mentasta Herd. Designating the Macomb caribou as a herd is consistent with Skoog's (1968) herd definition, "...thus a herd becomes an entity (subpopulation) when it establishes a calving area distinct from that of any other herd and uses this area repeatedly over a period of years." The Macomb Herd has calved in an area distinct from that of any other herd since at least the mid-1950's. Also, there are a number of additional reasons, as follows, for designating the Macomb caribou a discrete herd. The Mentasta Herd has continued to calve in the Wrangell Mountains and has not recently (perhaps never) occupied the range of the Macomb Herd even during winter and summer (Bos 1974). Sex and age structure and recruitment in the Macomb Herd differ from those of the Delta and Mentasta Herds. For management purposes, the Macomb Herd has been considered distinct from the Mentasta and Delta Herds. Between October 1966 and March 1968, 205 Delta Herd caribou were marked with metal ear tags and plastic ear streamers by the University of Oklahoma (Department of the Army Project 1577) and none of these marked animals have been seen east of the Delta River (Hemming 1971).

## Productivity

Fall sex and age composition counts of the DCH (as defined by Hemming 1971) have been conducted annually since 1969, and mid-June calf production/survival data are available for most years since 1973. Calf survival and yearling recruitment indices available for the years 1969-75 suggested poor productivity. In 1975 Davis and Neiland (1975) proposed a study to identify and assess the causes of recruitment failure between 1973 and 1975, but the study was not funded. In 1976, after initiation of a wolf (Canis lupus) control program, there was a dramatic increase in calf survival. Surveys conducted in 1976 showed that there were 56 calves:100 cows in late June, 3 weeks after calving, and 45 calves:100 cows during October. Nevertheless, recruitment to yearling age appeared to remain poor because only 12 yearlings:100 cows were counted the following June. This trend continued in 1977, suggesting that overwinter mortality was the predominant factor limiting recruitment of yearlings into the herd. Subsequent study showed that overwinter mortality was overestimated for winters 1976-77 and 1977-78.

Fluctuations in the size of Alaska's caribou herds have been common and are well documented (Skoog 1968; Hemming 1971; Davis 1978, 1980); however, many early estimates of herd size should be viewed skeptically. At least 3 hypotheses explaining North American caribou declines were advanced over the past 30 years

(Bergerud 1974). Bergerud (1974, 1980) critically examined hypotheses explaining these declines and concluded that human harvests and fluctuating natural mortality rates generally determine population trends. He also concluded that natality is high and relatively constant within herds or subpopulations; our recent findings in Alaska support his conclusion (Davis and Valkenburg 1978, 1979, 1981a, 1981b; Davis et al. 1978, 1980). However, net productivity may be the same when natality and early mortality are both high or when they are both moderate or low.

Mortality rate of calves may be closely related to condition at birth. For instance, mortality of neonates could be increased by stress in pregnant females as Verme (1967, 1969, 1979) documented in upper Michigan white-tailed deer (Odocoileus virginianus). Only through long-term studies, preferably involving marked animals, will we definitively ascertain the influence of environmental variables on natality, mortality, and caribou population dynamics.

Recommendations from a workshop (Klein and White 1978), attended by leading caribou workers in North America, identified the need for intensive demographic study of 1 or more caribou herds in Alaska. The opportunity to manipulate hunting pressure and predation rates on the DCH, and its proximity to the logistical and research support available in Fairbanks make this herd the best choice for studies. Hypotheses derived during investigations of the larger Western Arctic and Porcupine Herds regarding some aspects of general caribou ecology may be more feasibly tested on the DCH. Also, results of recent study of the DCH (Davis and Preston 1980) revealed that herd demography was misunderstood from 1975 through 1979. The DCH will continue to be intensively managed, so a thorough understanding of its demography is essential.

Davis and Neiland (1975) reviewed and compiled all available data for the DCH in 1974. Additional background information was presented by Davis and Preston (1980), Davis and Valkenburg (1981a, 1983), and Davis et al. (1982, 1983).

Proximity of the DCH to Fairbanks, considerable background information on the herd, and options to intensively manage (i.e., manipulate) the herd make it ideal for long-term demographic study. During the past 13 years, the DCH declined dramatically (from 5,000 in 1969 to 2,500 in 1975) and increased even more dramatically (from 2,500 in 1975 to 7,000+ in 1982). During this time, extremely high and low levels of both natural mortality and harvest occurred, and much was learned about caribou population dynamics. More importantly, much was learned about the large-mammal-and-man/predator-prey system in Game Management Subunit 20A (Gasaway et al. 1983).

By continuing to study the DCH's demography and simultaneously increasing study of the herd's behavior, nutrition, energetics, and interaction with the biotic (including predators) and abiotic environment, we should ultimately understand caribou ecology to the degree presently demanded by the growing pressures on caribou and their habitat.

Since study of the DCH was intensified in 1979, considerable data on herd movements and distribution have been collected incidental to fulfilling major objectives. Skoog (1968:202, 655) and Bergerud (1974) have discussed mechanisms of how movements and distribution of caribou affect herd demography. As caribou population density increases in a given herd, caribou travel more widely and may begin using more marginal ranges. Use of marginal ranges could result in higher mortality and possibly lowered natality or increased morbidity due to greater energy expenditures, poorer quality forage, and greater vulnerability to predation.

Implications of movements and distribution of caribou herds to population demography are sufficient to warrant collation and analysis of existing movement and distribution data. If the DCH continues to increase, any change in movements and distribution will be better interpreted if earlier patterns are well documented.

The present management goal for the DCH is to maintain a precalving herd of 5,000-6,000. However, reevaluation is continuing and other goals may become more appropriate.

## OBJECTIVE

To determine the demography of the DCH under varying rates of natural mortality and harvest by humans.

## 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 9,600 $km^2$ 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 1,830-2,740 m in elevation interspersed with

glacier-capped mountains exceeding 3,660 m. The northern foothills of the Alaska Range are flat-topped ridges 610-1,370 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 transition is abrupt from the foothills to the Tanana Flats. The Flats have little relief and elevations range from 13-300 m. The Flats are underlain by permafrost, and drainage is poor, resulting in numerous shallow ponds and extensive bogs.

Fire has greatly influenced the lowland vegetation. The result has been the creation of a mosaic of shrub and young forest dominated seres, climax bogs, and mature black spruce (Picea mariana) forest (LeResche et al. 1974). Fires have also occurred on the calving area and adjacent tundra and uplands (Davis et al. 1985). Vegetation in the hills, foothills, and mountains grades from taiga of white spruce (P. glauca), black spruce, paper birch (Betula papyrifera), and quaking aspen (Populus tremuloides) into shrub communities of willow (Salix spp.), and dwarf birch (B. glandulosa and B. nana) at low elevations with alpine tundra at high elevations (LeResche et al. 1974).

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 to 50 cm and rarely exceeds 80 cm. Ground vegetation in the foothills and mountains is frequently exposed during the 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 1950's. Most calves are born in 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.

In this report, all references to the DCH prior to 1980 include the Delta and Yanert Herds.

## PROCEDURES

### Radio-collaring

From 4 through 11 January 1979 and on 30 March 1979, we radio-collared 25 DCH calves (8-10 months of age). No caribou were radio-collared in 1980. In spring 1981 we radio-collared 12 Delta Herd caribou and 8 Yanert Herd caribou. From 1 July 1981 through 30 June 1982, we radio-collared 21 Delta caribou; of the 21 caribou, 10 were originally radio-collared in 1979 as 8- to 10-month-old calves. Their collars were replaced in 1982 because of expected battery failure after approximately 36 months. The 11 caribou captured for the 1st time were all 11-month-old females (i.e., short yearlings).

On 1 April 1983, we radio-collared 13 caribou; all except 1 were 10-month-old females. After 1 April 1983, there were 37 known-aged females, from 4 separate cohorts, radio-collared within the range of the DCH. In addition, there were 3 female and 1 male Delta caribou with active radio collars, but whose age was known only by estimate from cementum annuli of an incisiform canine tooth (Miller 1974).

On 30 March 1984, we radio-collared 12 female caribou (all 10 months old) from the range of the DCH.

All radio collars were constructed of triple-layered, rubberized machine belting to which was attached a hermetically sealed metal box containing the transmitter and batteries. Radios were activated by removing a magnet from the transmitter box. A highly visible vinyl-covered canvas collar, 15.2 cm wide and 71 or 86 cm long with 10 cm high numerals of a contrasting color, was pop-riveted to each radio collar. The entire unit weighed less than 850 g. All radios contained movement-sensitive mortality switches (Telonics, Inc., Mesa, Ariz.) to ascertain when caribou died. Normal pulse frequency was approximately 60 beats per minute. When movement ceased for approximately 4 hours the pulse would double or triple.

The radio collar machine belting was permanently fastened by bolts on female calves. These were put on tight enough to prevent slipping over the head when antlers were shed, yet to allow growth of the neck to adult size. Young males presented a problem because if collars were permanently fastened tight enough to stay on when antlers were shed, strangulation as adults was possible. When radio-collaring began in 1979, available data suggested that overwinter calf mortality averaged 80%. Therefore, it was believed that most young males would have died before permanently fastened collars caused strangulation. We planned to immobilize and remove collars

from any survivors at the end of the study. However, when we received our radios in late December 1978 (which we originally had planned to use in October 1978), reconnaissance of the DCH revealed that few if any calves had died since late October when sex and age composition counts were conducted. Also, during the October composition counts we saw many more young bulls (apparently 1-, 2-, and 3-year-olds) than expected from previous survey data. Therefore, we hypothesized that existing methods grossly underestimated overwinter calf survival and that we should expect good survival of the calves we planned to collar. Consequently, we hastily devised an expandable collar for the male calves. The machine belting of the radio collars was "temporarily" fastened snugly around the necks of the male calves by using 2 pieces of surgical tubing. The visual collars, pop-riveted over the radio collars, were permanently fastened at a length suitable for adult size. We hoped that the surgical tubing would hold the collars on into the following summer or fall. We reasoned that neck size would increase enough during summer to retain the collar after the surgical tubing separated. The "experimental" expandable collars were not successful and subsequently only female juvenile caribou were radio-collared.

Capture/Immobilization

In 1979 all calf caribou to be collared were visually located from a fixed-wing aircraft (C-185 or PA-18-150 Super Cub). A helicopter (Bell 206B) and immobilizing equipment were used (Cap-Chur, Palmer Co., Douglasville, Ga.) for capturing the calves. The immobilizing drug consisted of 1.5 to 4.5 cc of etorphine (M99, D-M Pharmaceuticals, Inc., Rockville, Md.) and 20 mg of xylazine (Rompun, Haver-Lockhart, Shawnee, Kans.). The antagonist diprenorphine (M50-50, D-M Pharmaceuticals, Inc., Rockville, Md.) was administered in equal volume to the etorphine.

In 1981, capture techniques were the same as those used previously (Davis and Preston 1980) except that a shoulder-held net gun (Mountain Helicopters, Greymouth, New Zealand) was used for capturing some caribou.

Caribou to be captured from 1 July 1981-30 June 1982 were first visually located (by radiotelemetry for those already radio-collared) from a fixed-wing aircraft (Bellanca Scout or Piper Super Cub). A helicopter (Bell Jet Ranger) and a Cap-Chur gun were used to capture the caribou. The immobilizing drug consisted of 5.0 mg (1 mg:ml) of etorphine for the 10 adult caribou. The dose for the 11 short yearlings was 4.8 mg of etorphine and 20 mg (100 mg:ml) of xylazine. The antagonist, diprenorphine, was administered intravenously and/or intramuscularly in the same volume (2 mg:ml) as the etorphine.

Caribou not completely immobilized by the drug(s) were pursued on foot and either tackled or captured with a shoulder-held net gun.

The caribou captured in 1983 were all captured by chemical immobilization following the procedures described by Valkenburg et al. (1983) and Davis and Valkenburg (1983). The only change was in the immobilizing drug: each caribou was darted with a 5 ml dart containing 0.5 ml (10 mg:ml) acepromazine (Ayerst Laboratories Inc., New York, N.Y.) and 4.5 ml (1 mg:ml) of etorphine.

The caribou captured in spring 1984 were all captured by chemical immobilization following the procedures described for prior years.

Relocating Radio-collared Caribou

Radio-collared caribou were relocated from fixed-wing aircraft (Bellanca Scout and Piper Super Cub) equipped with 2 Yagi antennas (either 3 or 4 element or "H"), one attached to wing struts on each side of the plane. The antenna leads were attached to a right/left switch box which coupled to a radio receiver/scanner (Telonics Inc., Mesa, Ariz.). In most years 1 or more flights were made each month. All collars were monitored audibly during each flight and an attempt was made to determine the general location of each signal heard. Several caribou were selected to be visually located during each flight. On some flights we visually relocated all collared caribou. A number of collared caribou were sighted from the ground during June and July 1979 by Department personnel conducting sheep (Ovis dalli) studies and caribou composition counts.

We also received some reports from the public and specifically hunters on the locations of collared caribou either observed or shot. For each sighting we attempted to record group size, location, presence or absence of a calf, group composition, habitat, reaction to the aircraft, presence of other radio collars in the same group, snow condition, and other appropriate information. During the calving period we recorded antler development, whether or not the females had distended udders, and the presence or absence of a newborn calf.

When a mortality signal mode was heard, the collar was visually located and evidence of mortality noted. A helicopter was flown to the vicinity at a later date and the kill was relocated from the ground with the aid of a hand-held antenna attached to a receiver. An investigation of the caribou remains and the adjacent area was made to determine the cause of death. Tracks, scats, and hair around the carcass were noted and photographs were taken.

Morphometry/Physiology

From each radio-collared caribou, we obtained, or attempted to obtain, morphometric, physiological, and live weight data as reported previously (Davis and Preston 1980; Davis and Valkenburg 1981a, 1983, 1984; Davis et al. 1982).

The following body measurements were taken: shoulder height, total length, heart girth, metatarsal length, hindfoot length, face length, neck circumference, and ear notch length. Length of the main beam of each antler was measured if antlers were present. Most calves and some adults were weighed.

Blood samples were taken by jugular venipuncture using 18-gauge 1-1/2 in needles and vacutainers. Plain vacutainers were used to collect blood for serum and EDTA vacutainers were used to collect whole blood. Hair samples (only taken in 1979) were taken from the dorsal midline in the scapular region, and tooth eruption was checked to confirm age and/or an incisiform canine tooth was taken for age determination using cementum annuli (Miller 1974). Whole blood was analyzed by project staff or by Mt. McKinley Animal Hospital, Fairbanks, Alaska. Sera were analyzed by Reference Laboratory, Newbury, California.

Calving/Productivity/Recruitment

During 1980-81, calving distribution, chronology, and success was monitored using fixed-wing aircraft to relocate radio-collared cows from the range of the DCH and also those collared in the Yanert River drainage. A concerted effort was made to determine if separate calving areas existed for the Delta and Yanert caribou. Productivity and recruitment were investigated by monitoring the radio-collared females throughout the year. In addition, herd composition surveys were conducted on 15 October 1980, 3 November 1980, and 17 June 1981.

During 1981-82, calving distribution, success, and chronology of the DCH and Yanert Caribou Herd (YCH) were monitored by 5 fixed-wing surveys of radio-collared and associated caribou in late May. No surveys were conducted from the ground.

Herd productivity and recruitment were investigated by measuring natality, estimating mortality rates by monitoring radio-collared caribou, and by modeling of the DCH's population dynamics. Sex and age composition surveys of the herd were conducted in May and October. L. Jennings and D. Yount conducted a standard fall composition survey on 8 October 1982 using a helicopter to classify caribou from the air, supplemented by classification from the ground using a 20X-60X spotting scope. In May, we flew several fixed-wing surveys

over the calving area to document calving progression and record the ratio of calves to animals older than calves. No distended udder surveys and herd composition counts were conducted in conjunction with the 1982 photocensus because of inadequate funding for a helicopter.

During 1982-83, calving distribution, success, and chronology of the DCH and YCH were monitored by 5 fixed-wing surveys of radio-collared and associated caribou in late May. No surveys from the ground were conducted. Herd productivity and recruitment were investigated by measuring natality, estimating mortality rates by monitoring radio-collared caribou, and by modeling of the DCH's population dynamics. Sex and age composition surveys of the herd were conducted in May and October. L. Jennings and P. Karczmarczyk conducted a standard fall composition survey on 4 October 1983 using a helicopter to classify caribou from the air, supplemented by classification from the ground using a 20X-60X spotting scope.

During 1983-84, calving distribution, success, and chronology of the DCH and YCH were monitored by fixed-wing surveys of radio-collared and associated caribou on 6 days in late May. No surveys were conducted from the ground. Herd productivity and recruitment were investigated by measuring natality, estimating mortality rates by monitoring radio-collared caribou, and by modeling of the DCH's population dynamics.

During spring 1984, yearling recruitment was estimated by using a helicopter to conduct herd composition counts in April. Fixed-wing aircraft were used to estimate natality rate by monitoring radio-collared cows. A. T. Bergerud and H. Butler obtained natality/survival data from ground composition surveys on the DCH calving ground. Herd sex and age composition was determined in conjunction with the photocensus in June 1984.

Herd Identities

Discreteness of the DCH and YCH and their relationships to neighboring Macomb, McKinley, and Nelchina Herds were determined by monitoring movements and calving distribution of caribou that were previously radio-collared in the range of and tentatively identified as members of the DCH or YCH. This effort was complemented by continuing studies of the other herds, particularly the Nelchina Herd (Pitcher 1982, 1983, 1984), Macomb Herd (D. Johnson, ADF&G files), Fortymile (ADF&G files), and Denali (F. Singer, pers. commun.).

Delta and Yanert Herd Censuses

From 16-18 June 1981, we assisted ADF&G biologists L. Jennings and E. Crain in conducting an aerial photo-direct count-extrapolation (APDCE) census of the DCH. Postcalving aggregations were found by searching from airplanes and by locating

radio-collared caribou. Aggregations were photographed with both 35 mm color and 230 mm (9x9 in) black and white film. Sex and age composition of caribou was sampled from the ground by observers with spotting scopes during the census and from both a helicopter and the ground during the rut. The Yanert River drainage was included in the census area.

The modified APDCE census procedure (Davis et al. 1979) was used during the 1982 DCH census. The principal modification of the APDCE technique developed by Hemming and Glenn (1968) involved adjustments that preclude relying on summer and fall herd composition data to extrapolate the population estimate. A more recent modification is the use of radio-collared caribou to locate aggregations to be photographed or visually counted in APDCE or modified APDCE censuses (Valkenburg et al. 1985).

Increasing use of radio-collared caribou to locate aggregations during censuses prompted us to assess validity of this approach by comparing 1982 population estimates derived by 2 independent methods for the YCH (Davis and Valkenburg 1983). One estimate was derived by counting only caribou aggregations containing radio-collared individuals and closely associated groups (i.e., groups encountered in the process of locating the radio-collared caribou). A 2nd estimate included caribou located during the aerial search of the entire range of the YCH.

J. Davis and W. Lentsch (pilot, Tamarack Air, Ltd.) flew a radio-tracking reconnaissance in a Cessna 185 on 21 June 1982 and found that Delta Herd caribou were sufficiently aggregated for censusing. On 22 May 1982, P. Valkenburg and J. Davis flew a Bellanca Scout to radio-locate aggregations and to visually search the census area. They directed L. Jennings (photographer) and W. Lentsch, who were flying in a Super Cub, to each aggregation. Each aggregation was photographed with a hand-held auto-wind 35 mm SLR Nikon camera. After photographing the known groups, the Super Cub assisted in visually searching the census area.

The 35 mm color slides were enlarged to 130 mm x 88 mm color prints. When necessary, endlap (i.e., overlapping coverage along a single flight line) and sidelap (i.e., overlapping coverage on adjacent flight lines) were delineated to ensure that discrete segments of a caribou group were counted on each print.

Several factors made counting caribou on the photos difficult. Varying scale and perspective due to the low altitude of the photo aircraft sometimes confounded photo analysis. Because of suboptimal photo quality and because many caribou were lying down and/or were in shrub cover, distinguishing calves from adults was impossible. Many calves were probably not detected

on some photos. Errors resulting from incorrect delineation of overlap were insignificant. L. Jennings and E. Crain each independently interpreted the photos.

The YCH was censused systematically for the 1st time in 1982. On 23 June 1982, J. Davis (observer) and W. Lentsch (pilot) used a Super Cub to locate the 7 radio-collared Yanert caribou (Table 1). All caribou associated with the radio-collared caribou were visually counted and classified as calves or older than calves. Immediately following those activities, Davis and Lentsch visually searched 100% of the caribou habitat in the Yanert River watershed. All caribou were again visually counted and classified as calves or older than calves. The visual census was completed on 24 June in a Cessna 185 with L. Jennings and J. Davis as observers and W. Lentsch as pilot. The personnel involved believed that no caribou were missed or counted twice during the 2-day census because of caribou movements in and out of the 2 areas. However, this does not imply a 100% sightability of caribou during the survey.

The modified APDCE census procedure (Davis et al. 1979) was used during the 1983 DCH and YCH censuses. The DCH and YCH were censused concurrently on 14 and 15 June. Three spotter-planes (2 Super Cubs and a Bellanca Scout) were used, 2 of which were equipped with radio-tracking gear. Most aggregations were photographed from a De Havilland Beaver with a belly-mounted 9x9 in Fairchild T-11 aerial camera using black and white Kodak XX Aerographic film (ASA 400). Some of the smaller aggregations were photographed with 35 mm Ektachrome 200 positive film and hand-held auto-wind cameras.

The June 1983 DCH census produced a smaller estimate of herd size than expected based on projections of recruitment and mortality since the June 1982 census. Uncertainty caused by the lower population estimate and concern generated by an estimated harvest of 1,000-1,500 caribou from the DCH during the hunting season in August and September 1983 were the impetus to conduct another census of the DCH on 4 October 1983. The census was designed to produce the highest known minimum population estimate with the least amount of cost while simultaneously locating the herd for sampling of herd sex and age composition. P. Valkenburg and R. Boertje audibly located 38 of 41 radio-collared Delta caribou (including 1 Yanert Herd caribou that moved to the DCH in 1982) using a Bellanca Scout for the reconnaissance, and they visually counted and/or photographed (with 35 mm SLR cameras) all caribou associated with the radio-collared caribou. (We subsequently learned that the 3 unlocated radio-collared caribou were dead prior to 4 October 1983). They directed L. Jennings and P. Karczmarczyk, in a helicopter, to the aggregations and the helicopter crew obtained sex and age composition data.

In 1984, the DCH and YCH were censused in mid-June using the modified APDCE procedure.

Natural Mortality

The natural mortality rate of caribou older than calves was estimated by determining the natural mortality rate of female radio-collared caribou (Davis and Valkenburg 1981b, Davis et al. 1982). Natural mortality of calves was estimated through serial herd composition surveys and modeling.

The mortality rate of radio-collared caribou was calculated from a procedure empirically derived by W. Gasaway (Gasaway et al. 1983) as follows:

$$\text{percent dying annually} = \frac{a}{b}$$

where

a = number of mortalities tallied among radio-collared animals

b = estimated number of collared animal-years (if the time interval differs from 12 months, units will not be in years). A collared animal-year is equivalent to 12 collared animal-months; a collared animal-month is equivalent to 1 radio collar functioning on 1 animal for 1 month.

b is estimated as follows:

$$b = \frac{c \cdot d}{e}$$

where

c = mean number of months that collars were transmitting, excluding animals that died

d = total number of radio-collared animals, including animals that died

e = time interval--12 months for annual mortality (the number of months differs from 12 when calculating seasonal rates of mortality).

This formula underestimates mortality rates when there are both a seasonal peak in mortality and radio transmitter failure during the observation period. An alternate method for calculating mortality rates has been reported by Trent and Rongstad (1974).

## Harvest

Responsibility for documenting harvest by humans has been assigned to the ADF&G management staff under the Survey and Inventory Program.

## Population Dynamics

The DCH's population parameters were estimated by modeling, using data from censuses and from indices and surveys of recruitment and mortality. The natural mortality rate of caribou older than calves was estimated by modeling and by determining the natural mortality rate of radio-collared caribou (Davis and Valkenburg 1981b, Davis et al. 1982). Natural mortality of calves was estimated through serial herd composition surveys.

# RESULTS

## Radio-collaring

Results of radio-collaring through 1983 have been previously reported (Davis and Preston 1980; Davis and Valkenburg 1981a, 1983, 1984; Davis et al. 1982). A summary of all caribou tagged through June 1984 appears in Table 1. Capture success and down times were similar to those previously reported (Valkenburg et al. 1983) (Table 2).

## Relocating Radio-collared Caribou

Relocating caribou during this project contributed data that were incorporated into 2 papers (Davis et al. 1985, Valkenburg and Davis 1985) presented at the First North American Caribou Workshop (Appendix A). All relocations through 1984 have been entered into the Data Star "A" computer data file and analyses will appear in future Federal Aid P-R reports covering continuing research on Delta Herd caribou.

## Morphometry/Physiology

Measurements and live weights collected through June 1983 were reported previously (Davis and Preston 1980; Davis and Valkenburg 1981a, 1983, 1984; Davis et al. 1982). Data from caribou radio-collared in March 1984 are included in Table 2. Teeth from the caribou handled in 1984 have not yet been sectioned and aged, but eruption patterns of 10-month-old calf incisiform teeth captured in 1984 are summarized in Table 3.

Serological data are currently being analyzed in conjunction with data from other Interior and Arctic Alaska caribou herds.

Most samples taken to date have also been tested for antibody presence to 3 viruses and 2 bacteria (Zarnke 1983, 1984) and for genetic variation (Røed and Whitten, pers. commun.). We will report the hematology results in future reports.

Calving/Productivity/Recruitment

Data and discussion regarding calving, herd productivity, and recruitment through June 1983 have been reported (Davis and Preston 1980; Davis and Valkenburg 1981a, 1983, 1984; Davis et al. 1982, 1983, 1985; Gasaway et al. 1983; Appendix A).

Calving distribution in 1984 was of particular interest because a considerable portion of the DCH females calved and/or were distributed during calving with YCH females in the upper Wood and Yanert Rivers.

In 1984, calving distribution and natality were monitored by using fixed-wing aircraft to relocate radio-collared caribou, by a 2-person ground crew spending 20-23 May 1984 classifying caribou on the traditional "core" calving area, and by using a helicopter on 26 May 1984 for a composition count in the upper Wood River area.

Flights to relocate radio-collared caribou were conducted on 14, 16, 18, 20, and 26 May 1984. These flights documented the 1st occurrences of radio-collared Delta caribou calving in areas not contiguous to the traditional Delta core calving area. The flights also documented the earliest "postcalving" movement from the traditional core area. Data from these flights, and the ground crew's observing only about 500 caribou in the traditional eastern core calving area, suggest that considerable calving occurred immediately northwest of the traditional calving area and/or rapid movement occurred to the southwest during calving. Of 5 radio-collared cows that were located on or adjacent to the traditional calving area on 14 May 1984, 3 had moved an average of about 7 miles to the southwest by 16 May. All 3 of these were located in the upper Wood River when next monitored on 26 May. In contrast, 2 of the 5 collared caribou relocated on both 14 and 16 May and that had moved northwest or due south between 14 and 16 May were not located in the Wood River area on 26 May. This is further evidence of a rapid large-scale movement, during and/or shortly after calving, from the traditional calving area to the upper Wood River.

A. T. Bergerud (Univ. of Victoria, Canada) and H. Butler (Univ. of Calgary, Canada) collected pregnancy/natality data in the eastern traditional core calving area, by ground observations, from 20-24 May. They classified 482 females and 1 male. Of the 482 females, 94% (453:482) had carried a calf to term or

were still pregnant based on antler retention and udder condition criteria (Bergerud 1964). At the time of classification, 60 calves had been lost, so the maximum calf:cow ratio observable in the field would have been 82 calves:100 cows (393:482), assuming no additional calves died before calving was 100% completed.

On 24 May, Bergerud and Butler observed 139 cows that had shed both antlers, 9 that had shed 1 antler, and 19 that retained 2 antlers. These data provide insight into the chronology of calving. If we assume that cows with 1 or more retained antlers were possibly still pregnant, then a minimum of 83% (139:167) of all females had calved prior to 24 May.

In contrast, P. Valkenburg classified 213 caribou on 26 May 1984 in the upper Wood River area and observed 22 calves:100 cows. In a subsample of the 213, Valkenburg concluded that 13% of 173 cows were possibly still pregnant on 26 May. If 13% of all cows were still pregnant, the maximum calf:cow ratio observable in the field would be only 35 calves:100 cows. This contrasts with a potential of 82:100 for the traditional core area. Yearling and subadult females have aggregated in past years in the upper Wood River area, which is 1 explanation to account for the observed poor calf:cow ratio. Another possibility is that the entire sample of 213 was taken from a biased, unproductive portion of all caribou in the area. Strong wind and heavy cloud cover precluded subsampling from groups observed near ridgetops and higher elevations. These groups may have contained higher calf:cow ratios. For example, 173 females tallied on the Wood River floodplain were accompanied by only 14 calves and only 22 cows had distended udders. In contrast, the additional 40 cows classified were on an upper slope in a cloud-free area, and they were accompanied by 30-35 calves.

Subsequent herd composition surveys showed that the 26 May 1984 data underestimated overall herd natality. In conjunction with the 1984 Delta/Yanert census (22 June 1984), a sample of 2,604 caribou yielded a ratio of 56 calves:100 cows (Table 4). The 17 October 1984 composition count showed 36 calves:100 cows ($\underline{n}$ = 1,093).

In summary, the 26 May 1984 calf:cow ratio observed in the Wood River area was clearly an underestimate of herd natality and early survival. Data are lacking to determine if the lower calf survival in 1984 was attributable to the unprecedented early postcalving movement from the traditional calving area to the Wood River area, and the limited calving by Delta caribou in the Wood River area. We were unable to make that determination by examining the calving success of individual Delta and Yanert radio-collared cows.

On 18 May 1984 the following Delta caribou were distributed in the Wood River area: BKY0, BKY10, BKY20, BKY27, BKY47, BKY48, BKO70, BKO72, and BKO77 (Fig. 2). In addition, BKY78 was in the headwaters of Healy River on 18 May. Reproductive status for each of these caribou is summarized in Table 5. Five of 25 radio-collared Delta cows $\geq$36 months old were distributed outside the traditional Delta calving area during calving time in 1984. Of 24 radio-collared DCH females 12 or 24 months old, 5 were located in the upper Wood River area during calving time in 1984. Fig. 2 depicts the juxtaposition of Yanert and Delta radio-collared females in the Wood River area during calving time in 1984.

Indices to yearling recruitment (i.e., 11-month-old calf:100 cow ratios) indicate that overwinter calf survival was high for both the DCH and YCH in 1983-84. On 10 April 1984 the DCH contained 49 calves:100 cows ($n$ = 628) (Table 4). On 13 April 1984 the YCH contained 44 calves:100 cows ($n$ = 167).

Herd Identities

Documenting that a portion of the DCH shared a common calving area with the YCH in 1984 will be of interest to students of caribou behavior/ecology. Currently, there is major debate over the complex subject of herd identity. The debate focuses on 3 components: (1) the basis for defining caribou herds, (2) Bergerud's (pers. commun.) working hypothesis that caribou optimally and dynamically use space (including short-term shifts in calving distribution) vs. the concept of long-term selection for calving grounds based on optimal foraging theory, and (3) the theoretical mechanisms contributing to herd dispersal and/or maintenance of herd discreteness.

The current Delta/Yanert situation can contribute useful empirical data to the conceptual models mentioned above, so additional monitoring will occur in 1985. Seven of the 8 Yanert Herd females radio-collared in 1981, prior to any known mixing of the DCH and YCH, were captured in fall 1984 and their radio collars were replaced (Table 1). Monitoring these 8 females and the radio-collared Delta cows, whose calving history is known, will provide additional data regarding herd identity and dispersal theory.

Monitoring radio-collared caribou and conducting aerial surveys in 1980 and 1981 had confirmed that the YCH was a herd separate and distinct from the DCH (Davis et al. 1982). Incidental observations by ADF&G staff (ADF&G files, Fairbanks) and area residents (Lynn Castle, Upper Wood River resident and big game guide, pers. commun.) suggest that the YCH existed as a discrete herd for many years prior to 1980-81 and the herd

consisted of several hundred caribou residing year-round, primarily in the Yanert River drainage.

During the June 1981 photocensus of the DCH, 431 caribou were observed in the Yanert River drainage. In November 1981, P. Valkenburg and R. Boertje observed about 500 caribou in the Yanert River drainage during a flight to monitor radio-collared caribou. Since the survey did not cover all of the Yanert River drainage, the herd probably contained a minimum of 500-600 caribou, assuming there had been no influx of caribou from the DCH. Data from 1982 complemented the 1981 data and supported the idea that the DCH and YCH were 2 discrete herds and suggested a minimum herd size of 680 for the YCH. Designating the YCH as a discrete herd was consistent with Skoog's (1968) criteria for herd identity.

Little mixing apparently occurred between Delta and Yanert caribou prior to the 1980's. Several members of the public reported that the YCH did not suffer acute calf recruitment failure from 1971 through 1976 as did the DCH. The ADF&G did not obtain calf recruitment data for the YCH from 1971 through 1976, but differences between calving behavior and calving success in the DCH and YCH during 1981 and 1982 suggest that the earlier reported differences were possible. In both 1981 and 1982, the YCH was widely dispersed during calving, unlike the DCH. All radio-collared Yanert cows calved at locations above 1,500 m and were usually on high, rocky ridges above nearby Dall sheep. This behavior is dissimilar to that reported for most barren-ground caribou herds. The YCH's calving behavior may be an adaptive strategy to escape predators, primarily wolves and grizzly bears (Ursus arctos) (Bergerud, pers. commun.). In contrast, the Delta caribou typically are gregarious (i.e., clumped) during calving (albeit during parturition they are normally solitary) and apparently exhibit clumping behavior as a strategy against predation (Cumming 1975).

Although fidelity to respective calving grounds continued in 1983, the DCH and YCH intermixed in summer 1983. Seasonal intermixing between the 2 "herds" increased during 1984. Investigating herd fidelity between the 2 "herds" is a priority for the future. Additional analysis of data from radio-collared caribou in the DCH and YCH will be presented in a paper titled, "Calving Ground Fidelity and Herd Identity of the Delta and Yanert Caribou Herds, Alaska." This paper will be presented at the 4th International Reindeer/Caribou Symposium, Whitehorse, Yukon in August 1985. An abstract for the paper appears in Appendix B.

## Delta and Yanert Censuses

The 1984 census resulted in a total of 6,227 caribou counted in the DCH and YCH (Appendix C) and an extrapolated APDCE census estimate of 6,260 (Table 6) for the DCH and YCH combined.

In prior years (1981, 1982, 1983), independent estimates were made for each of the 2 herds (Davis et al. 1982; Davis and Valkenburg 1983, 1984). Because the 2 herds were so intermixed during the 1984 census and had to be included in 1 combined estimate, we thought it imperative to recombine the earlier estimates for the DCH and YCH (Table 6).

For years prior to 1981, we subjectively assumed the YCH numbered 500. Results of censuses conducted prior to 1981 were summarized in previous reports and papers (Davis and Preston 1980). The number of caribou counted in the Yanert River drainage from 1981 through 1983 increased continuously from 431 to 929. One can infer from this that (1) we progressively became more efficient at locating caribou, (2) the number of "Yanert" caribou increased rapidly, (3) the number of "Delta" caribou in the Yanert area increased annually, or (4) some combination of these. We think a combination of (2) and (3) is most probable.

## Harvest

Davis and Valkenburg (1984) previously summarized historical harvest data for the DCH and YCH (Tables 7 and 8). During the 1984-85 hunting season, 418 and 90 caribou were reported harvested from the DCH and YCH, respectively. Sex of the harvested caribou was 258 males, 153 females, and 17 sex unreported for the DCH, and 71 males and 19 females for the YCH. Because Delta caribou were readily available west of the Totatlanika River where ATV access is excellent, the early hunting season quota of 300 caribou was exceeded (416 harvested) in only 4 days, and the season was closed by emergency announcement on 24 August 1984. In addition, concern about possible overharvest prompted a cancellation of the scheduled 1 February 1985 Delta opening. The Yanert River drainage was closed to caribou hunting by emergency order on 8 February 1985.

## Natural Mortality

Results of natural mortality rate investigations through 1983 have been previously reported (Davis and Valkenburg 1984). Results from 1984 will be reported in P-R Progress Reports for ongoing DCH studies.

## Population Dynamics

Data in Table 6 suggest the number of Delta/Yanert caribou increased annually from 4,191 in 1979 to 7,335 in 1982. No population trend from 1982 through 1984 is obvious. The increase from 1979 to 1982 suggests an annual increase rate ($\underline{r}$ = 0.20) of 22%. The population size may have been overestimated in the 1982 census because it was higher than the projected estimate from 1981. Disregarding the 1982 estimate and calculating the rate of increase from 1979 (4,191) to 1983 (7,229) reveals a mean annual increase rate of ($\underline{r}$ = 0.14) 15%. This high rate occurred even though harvest of the herd began in 1980 (Table 2).

Both rates, 22% and 15%, are possible, considering variability around apparent recruitment rates, mortality rates, and population sex and age structure. The annual change from 1979 to 1980 was ($\underline{r}$ = 0.07) 7%, and from 1980 to 1981 ($\underline{r}$ = 0.10) 11%. If these annual rates of growth are accurate, then most of the growth would have occurred from 1981 to 1982, but this is likely a result of our inability to precisely determine herd size. Recruitment and mortality data suggest the calculated annual growth rates from 1979 through 1982 were not widely divergent. It is more likely that we are unable to precisely measure annual changes of less than 10% or a greater proportion of the herd was located in the 1982 and subsequent censuses because of more intensive precensus reconnaissance, greater knowledge of herd distribution, and the presence of more radio-collared caribou.

Other possible interpretations of the census results include (1) the 1979 estimate was low, (2) a higher proportion of the herd was located from 1979 to 1982, (3) the 1981 census underestimated the herd size based on subjective impressions about the "goodness" of the pre-1983 censuses, and (4) most estimates are biased toward underestimation rather than overestimation because calves are not readily detected on the photos.

If a 1982 population estimate is projected from 1981 (assuming 15-22% annual growth), the apparent population dynamics through 1984 fit the data set reasonably well for population size and harvests. However, the 1983 and 1984 population estimates may have been conservative because the June 1983 census is known to be low based on an October 1983 count, and photo quality in 1984 was poor. It may be unwise to disregard a 1982 estimate with no known defect to make the 1983 and 1984 estimates "fit" better when both were of low quality.

Management implications of the 1984 census results and analysis of Delta/Yanert caribou population dynamics are:

1. Population goals in management plans call for a precalving population of 500-600 for the YCH and 5,000-6,000 for the DCH.

There are 6,300 total in both herds at this time. The 1985 harvest objective of 600 caribou is on the upper end of a "sustainable harvest" level. It appears the management program is meeting the objectives but careful monitoring of the harvest must occur because the harvest goal is near the maximum sustainable yield.

2. The probability of measurable net loss through emigration of the DCH or YCH is almost nonexistent based on radio-collared caribou.

3. Justification for managing the Delta and Yanert "herds" separately is still warranted, though it may be less essential based on the premise that the 2 areas may no longer support "discrete" herds.

## CONCLUSIONS

Statewide, caribou populations declined by 40% in the late 1960's and early 1970's (Davis 1978) because caribou were not managed with a clear understanding of the limiting factors acting on the population (Bergerud 1978). Davis and Neiland (1975) formulated a working hypothesis to explain population dynamics of the DCH, including a dramatic recruitment failure and population decline, as follows:

> "From review of historic data, it appears that the Delta Herd numbered from 300 to 1,500 caribou from the 1930's through 1957. After this there was a very rapid increase to more than 5,000, excluding calves, by 1964. This likely occurred through ingress from the Nelchina Herd. This large population was maintained more or less until the severe winter of 1970-71. It is likely that this winter was severe enough that direct winter mortality and decreased production and recruitment resulted. Substantial deterioration of range condition probably occurred during the years of high population from the early 1960's through 1970-71. It appears that ingress from the Nelchina Herd expanded population numbers in the Delta Herd well above what the long-range carrying capacity of the area was."

Results of this study indicate that the hypothesized major factors driving population dynamics in the above scenario (i.e., ingress/egress, direct mortality from weather, range deterioration, carrying capacity exceeded) were not major factors. Instead, exploitation by humans and predation were, and are, the major proximate factors driving population dynamics in the DCH. Our results support Bergerud's (1974) view of caribou population dynamics in North America.

## Caribou Demography, 1954-84

Caribou were scarce in the DCH's range from the mid-1930's until 1954. The 4 population estimates during this period indicated several hundred resident caribou. There were 1,500 caribou by 1957 and 5,000 by 1963 (excluding calves). Estimates from 1963 through 1970 were consistently about 5,000, including 1,000 caribou in the present range of the Macomb Herd.

The 1st APDCE census of the DCH (in 1973) estimated 2,198-2,409 caribou. Subsequent APDCE census estimates were 3,700-3,961 in 1979; 4,194-4,448 in 1980; 4,180-5,320 in 1981; 6,298-6,792 in 1982; and 6,040-6,300 in 1983. These estimates do not include the YCH. Estimates for the combined Delta/Yanert caribou population were: 1973, 2,804; 1979, 4,191; 1980, 4,478; 1981, 4,962; 1982, 7,335; 1983, 6,800-7,229; and 1984, 6,260. (Ranges in the estimates do not indicate confidence intervals; they are extrapolations by 2 methods). No censuses were conducted between 1973 and 1979, but calf survival data suggest that the herd declined through 1975 and began increasing in 1976. The mean fall calf:100 cows ratio for 1971-74 was 9.7 (SD = 5.8); following wolf control in 1976-81 the comparable ratio increased dramatically to 47 (SD = 9.5).

## Limiting Factors

There are many possible factors limiting population size in the DCH. Those discussed most are food quality and quantity, predation, and harvest. The roles of weather, emigration/immigration, disturbance, disease, catastrophe, and other potential limiting factors were considered, but they inadequately accounted for the observed population dynamics of the DCH. No habitat studies have been conducted for the DCH. However, nutrition indices such as rapid growth, early sexual maturity, high pregnancy rates, and high natality and calf survival rates indicate a high nutritional status. Calves were large at 7.5 months in 1979; live weight was 71.1 kg (SD = 5.4) for 8 males and 62.5 kg (SD = 2.8) for 9 females. Of 9 radio-collared female calves, at least 6 produced viable calves on their 2nd birthday. Five of these 6 again produced viable calves on their 3rd birthday. From 14-28 May 1979, we classified 479 cows and 98% had produced a calf. Based on these indices of nutrition and on the rapid increase of the DCH from 1976 to present, it is improbable that food quality and/or quantity could have recovered sharply in 1976 after decreasing sufficiently during the early 1970's to cause drastic population decline and poor calf survival. Further, range/energetic relationships of the DCH appear comparable to, or better than, those in the adjacent Denali Herd where Boertje (1981)

concluded that nutritional status was high and predation on calves less than 4 weeks old was presumably the key factor limiting the herd since 1972.

Exploitation by man, and predation (primarily wolves), appear to have had the most effect on the DCH's demography. No harvest data are available prior to inception of a mandatory harvest report program initiated in 1968-69, but it is believed that trophy hunting of adult males constituted the primary hunting pressure prior to 1968. Harvest peaked from 1970-73 when 7-19% of the herd was harvested annually.

Excessive harvest was a major factor in the precipitous decline of the DCH from 1970-73. However, calf survival during this period was so low that a decline would have occurred without hunting, and the decline continued from 1973 through 1975 after hunting was eliminated. Following rapid growth from 1976 through 1982, the herd has stabilized or declined in 1983 and 1984, coincident with increased harvest.

The DCH grew rapidly following 2 separate times when wolf numbers were significantly reduced. It increased rapidly from 1954 through 1963 following initiation of wolf control in 1954. Data are inadequate to describe the mechanism for growth during this period, but it is reasonable to believe that the herd grew from increased caribou survival due to lessened predation by wolves. An alternate unsubstantiated explanation assumes immigration from the Nelchina Herd.

The DCH grew rapidly beginning in 1976, coincident with a major reduction of wolves. Inferring cause-and-effect from lowering wolf numbers and the subsequent increase in caribou, is supported by the relatively constant calf survival in adjacent herds where wolves were not controlled. Following wolf control in 1976, the DCH fall calf:100 cows ratio increased from 2:100 in 1974 to 45:100 in 1976 (no fall 1975 data available, but there were only 13 calves:100 cows in June 1975). Comparable figures from the Macomb Herd were 15:100 in 1974 (no 1975 data) and 20:100 in 1976; and in the Denali Herd, 18:100 in 1974 (no 1975 data) and 16:100 in 1976. While the DCH population doubled from 1976 through 1981, the Macomb and Denali Herds remained at approximately 800 and 1,500, respectively.

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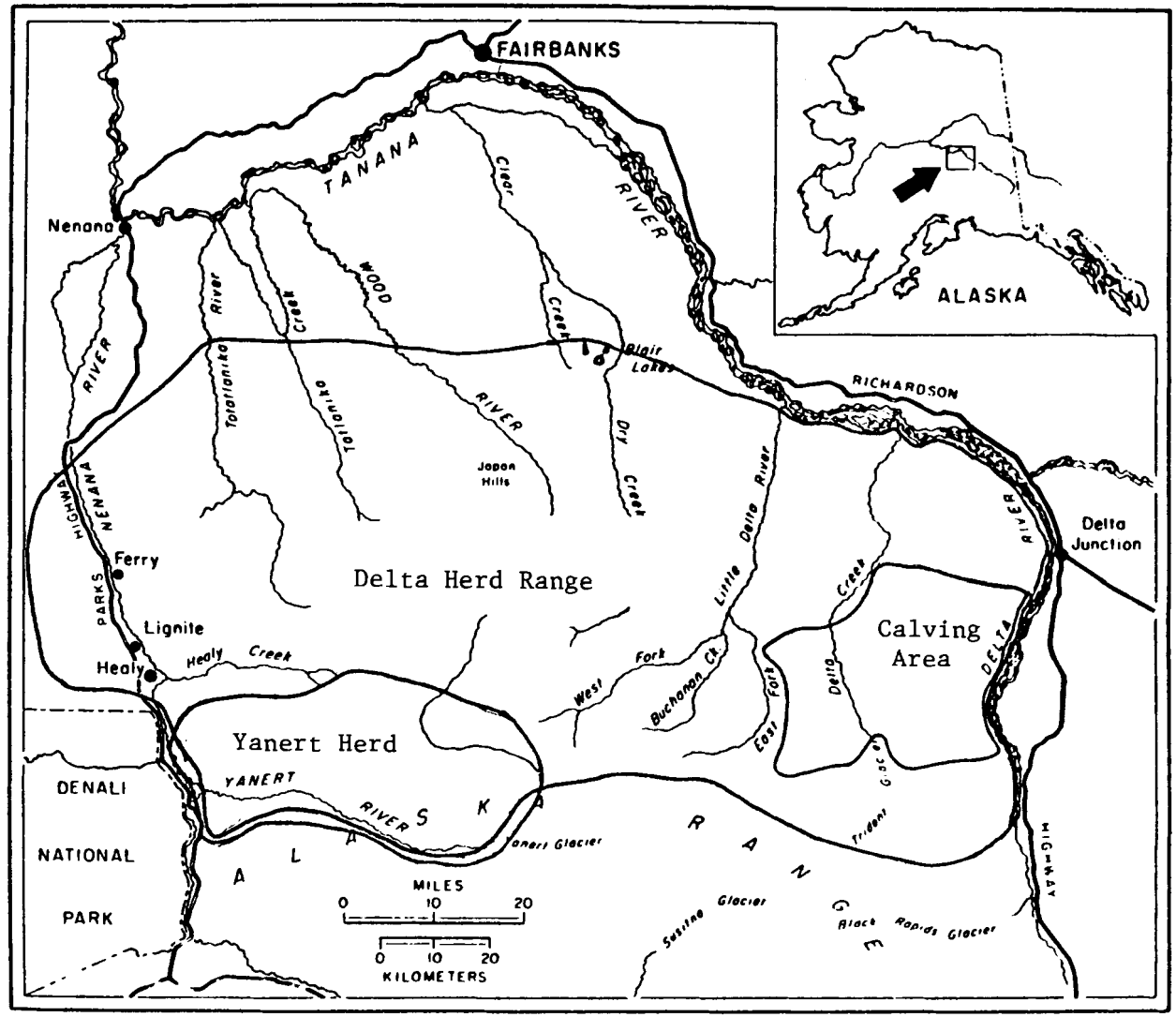


Fig. 1. Study area, ranges of the Delta and Yanert Caribou Herds, and Delta Herd calving area.

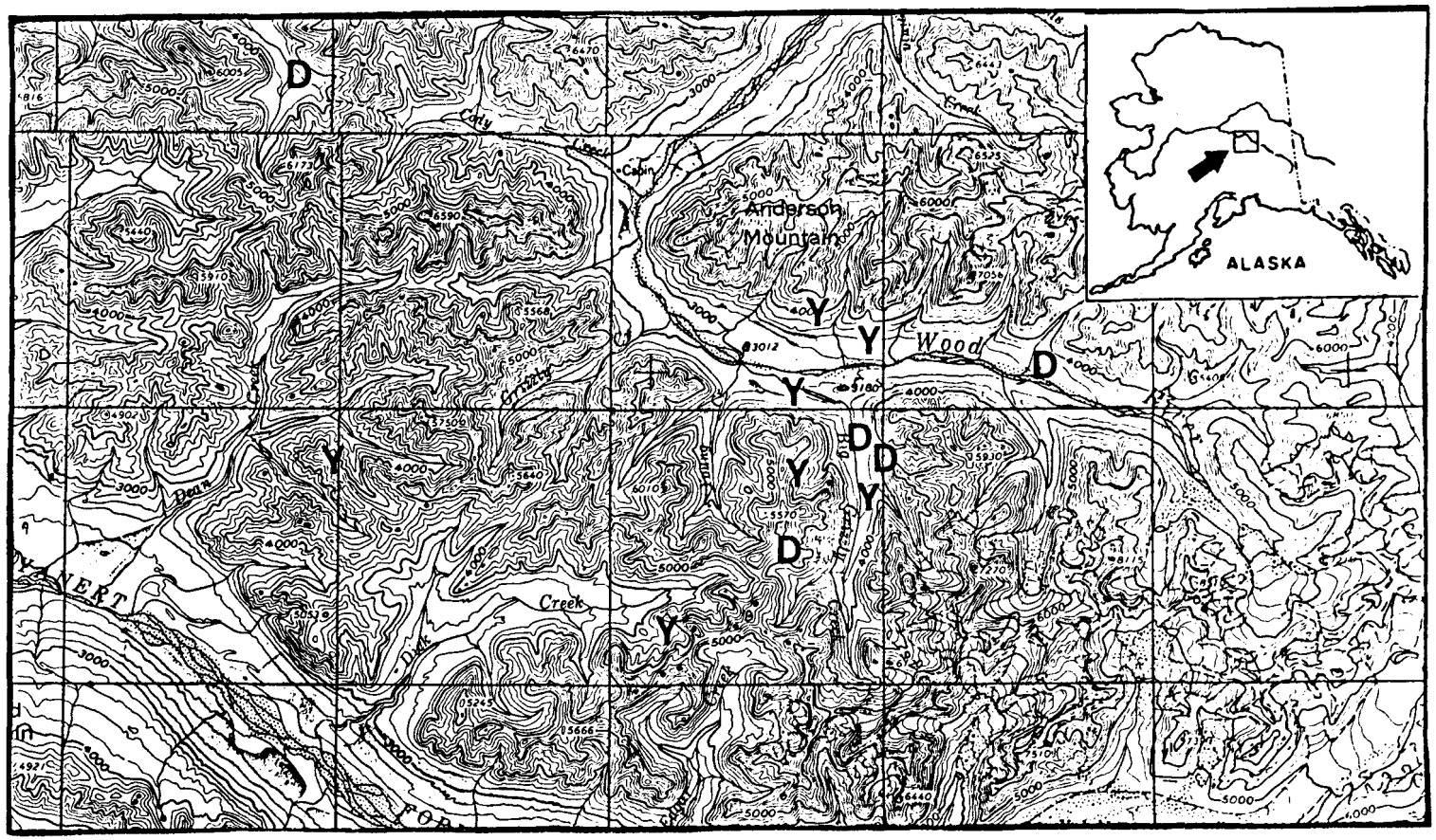


Fig. 2. Distribution of 36-month-old and older radio-collared cow caribou from the Delta and Yanert Herds sharing a common calving area, 18 May 1984. (D = Delta, Y = Yanert) (Scale = 1:250,000)

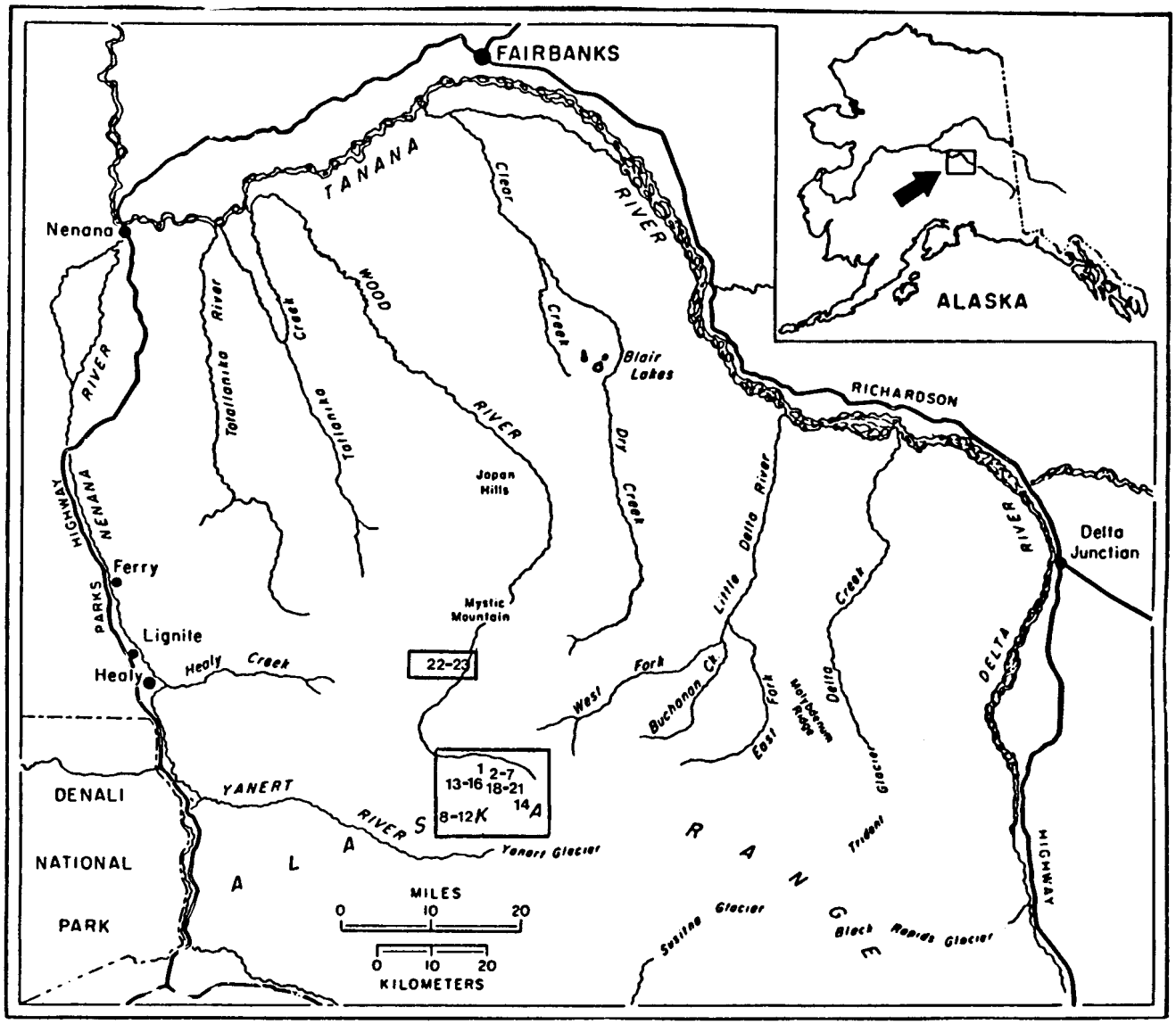


Fig. 3. Locations of postcalving aggregations of Delta and Yanert Herd caribou during the census, 20 and 21 June 1984. (See Appendix C)

Table 1. Permanent accession numbers and other pertinent information for radio-collared Delta and Yanert Herd caribou, 1979-84.

| Accession No.[a] | Collar No.[b] | Year of birth | Sex | Date collared (recollared) | Herd | Comments |
|---|---|---|---|---|---|---|
| 101,972 | YR-57<br>BKY-36 | 1978 | F | 1/4/79<br>(2/11/82) | Delta | |
| 101,973 | YR-53<br>BKY-28 | 1978 | F | 1/4/79<br>(2/11/82) | Delta | |
| 101,974 | YR-88<br>BKY-37 | 1978 | F | 1/8/79<br>(2/11/82) | Delta | |
| 101,975 | YB-62 | 1978 | M | 1/9/79 | Delta | Killed by wolves 2/79 |
| 101,976 | YR-17 | 1978 | M | 1/9/79 | Delta | Missing 4/79 |
| 101,977 | YR-78<br>BKY-49 | 1978 | F | 1/9/79<br>(2/26/82) | Delta | Died 3/82 |
| 101,978 | BKY-57 | 1978 | M | 1/9/79 | Delta | Died of unknown causes 3/79 |
| 101,979 | YR-18 | 1978 | M | 1/4/79 | Delta | Shot 11/80 |
| 101,980 | BKY-58 | 1978 | M | 1/10/79 | Delta | Missing 2/79 |
| 101,981 | YR-59<br>BKY-20 | 1978 | F | 1/10/79<br>(5/30/81) | Delta | Died from recapture |
| 101,982 | YR-52<br>BKY-78 | 1978 | F | 1/10/79<br>(2/11/82) | Delta | |
| 101,983 | BKY-59 | 1978 | M | 1/10/79 | Delta | Killed by grizzly 8/80 |
| 101,984 | YR-54<br>BKY-47 | 1978 | F | 1/11/79<br>(2/26/82) | Delta | |
| 101,985 | YR-58<br>BKY-79 | 1978 | M | 3/30/79<br>(2/11/82) | Delta | |
| 101,986 | BKY-69 | 1978 | M | 1/11/79 | Delta | Missing 2/79 |
| 101,987 | YR-19 | 1978 | M | 1/8/79 | Delta | Shed collar |

Table 1. Continued.

| Accession No.[a] | Collar No.[b] | Year of birth | Sex | Date collared (recollared) | Herd | Comments |
|---|---|---|---|---|---|---|
| 101,988 | YR-56<br>BKY-25 | 1978 | F | 1/4/79<br>(2/26/82) | Delta | |
| 101,989 | BKY-47 | 1978 | M | 1/11/79 | Delta | Shed collar 6/79 |
| 101,990 | BKY-58 | 1978 | F | 1/8/79 | Delta | Died during collaring |
| 101,991 | BKY-79 | 1978 | M | 1/10/79 | Delta | Radio failed 9/80 |
| 101,992 | BY-63 | 1978 | M | 1/11/79 | Delta | Radio failed |
| 101,993 | YR-76<br>BKY-26 | 1978 | F | 3/30/79<br>(2/26/82) | Delta | |
| 101,994 | YR-79 | 1978 | F | 3/30/79 | Delta | Radio failed |
| 101,995 | BKY-67 | 1978 | M | 3/30/79 | Delta | Missing 7/17/79 |
| 101,996 | YB-62 | 1978 | M | 3/30/79 | Delta | Never heard |
| 101,997 | YR-77<br>BKY-20 | 1978 | F | 3/30/79<br>(2/26/82) | Delta | |
| 102,341 | BKY-15<br>BKY-53 | 1980 | F | 2/8/81<br>(11/3/84) | Delta | |
| 102,342 | BKY-86 | 1979(?) | M | 2/8/81 | Delta | Killed 2/81 (wolves?) |
| 102,343 | BKY-13<br>BKY-54 | 1980 | F | 2/8/81<br>(11/3/84) | Delta | |
| 102,348 | BKY-14<br>BKY-68 | 1980 | F | 2/27/81<br>(10/30/84) | Delta | |
| 102,349 | BKY-12 | 1979(?) | F | 2/27/81 | Delta | Not recollared |
| 102,350 | BKY-22 | 1978(?) | F | 2/27/81 | Delta | Not recollared |
| 102,360 | BKY-16 | 1980 | F | 3/22/81 | Delta | Not recollared |

Table 1. Continued.

| Accession No.[a] | Collar No.[b] | Year of birth | Sex | Date collared (recollared) | Herd | Comments |
|---|---|---|---|---|---|---|
| 102,361 | BKY-21<br>BKO-46 | 1980 | M | 3/22/81<br>(11/2/84) | Delta | |
| 102,362 | BKY-18<br>BKO-74 | pre-1978 | F | 3/22/81<br>(11/3/84) | Delta | |
| 102,363 | BKY-29<br>BKO-49 | pre-1979 | F | 4/18/81<br>(11/3/84) | Yanert | |
| 102,364 | BKY-30<br>BKO-51 | pre-1980 | F | 4/18/81<br>(10/31/84) | Yanert | |
| 102,365 | BKY-31<br>BKO-64 | pre-1979 | F | 4/18/81<br>(10/31/84) | Yanert | |
| 102,366 | BKY-32<br>BKO-61 | pre-1979 | F | 4/18/81<br>(11/2/84) | Yanert | |
| 102,367 | BKY-33<br>BKO-60 | pre-1980 | F | 4/18/81<br>(10/31/84) | Yanert | |
| 102,368 | BKY-34<br>BKO-11 | pre-1979 | F | 4/18/81<br>(11/2/84) | Yanert | |
| 102,369 | BKY-35 | pre-1979 | F | 4/18/81 | Yanert | Not recollared |
| 102,370 | BKY-70<br>BKO-65 | pre-1979 | F | 4/18/81<br>(11/2/84) | Yanert | |
| 102,430 | BKY-19<br>BKO-66 | 1980 | F | 5/30/81<br>(11/3/84) | Delta | |
| 102,431 | BKY-23<br>BKO-63 | 1980 | F | 5/30/81<br>(10/30/84) | Delta | |
| 102,432 | BKY-27<br>BKY-51 | 1980 | F | 5/30/81<br>(10/30/84) | Delta | |
| 102,546 | BKY-9 | 1981 | F | 5/3/82 | Delta | |
| 102,547 | BKY-10 | 1981 | F | 5/3/82 | Delta | Eaten by grizzly |

Table 1. Continued.

| Accession No.[a] | Collar No.[b] | Year of birth | Sex | Date collared (recollared) | Herd | Comments |
|---|---|---|---|---|---|---|
| 102,548 | BKY-7 | 1981 | F | 5/3/82 | Delta | |
| 102,549 | BKY-6 | 1981 | F | 5/3/82 | Delta | |
| 102,560 | BKY-1 | 1981 | F | 5/3/82 | Delta | |
| 102,561 | BKY-4 | 1981 | F | 5/3/82 | Delta | |
| 102,562 | BKY-2 | 1981 | F | 5/3/82 | Delta | |
| 102,563 | BKY-5 | 1981 | F | 5/3/82 | Delta | |
| 102,564 | BKY-3 | 1981 | F | 5/3/82 | Delta | |
| 102,565 | BKY-0 | 1981 | F | 5/3/82 | Delta | |
| 102,566 | BKY-8 | 1981 | F | 5/3/82 | Delta | |
| 102,803 | BKY-40 | 1982 | F | 4/1/83 | Delta | |
| 102,804 | BKY-43 | 1982 | F | 4/1/83 | Delta | |
| 102,805 | BKY-41 | 1982 | F | 4/1/83 | Delta | |
| 102,806 | BKY-42 | 1982 | F | 4/1/83 | Delta | |
| 102,807 | BKY-39 | 1982 | F | 4/1/83 | Delta | Died summer 1983 |
| 102,808 | BKY-48 | 1982 | F | 4/1/83 | Delta | |
| 102,809 | BKY-10 | 1982 | F | 4/1/83 | Delta | |
| 102,810 | BKY-45 | 1982 | F | 4/1/83 | Delta | |
| 102,811 | BKY-44 | 1982 | F | 4/1/83 | Delta | |
| 102,812 | BKY-17 | 1982 | F | 4/1/83 | Delta | |
| 102,813 | None | 1982 | F | 4/1/83 | Delta | |
| 102,814 | BKY-46 | 1982 | F | 4/1/83 | Delta | |
| 102,815 | BKY-3 | 1982 | F | 4/1/83 | Delta | |

Table 1. Continued.

| Accession No.[a] | Collar No.[b] | Year of birth | Sex | Date collared (recollared) | Herd | Comments |
|---|---|---|---|---|---|---|
| 102,982 | BKO-76 | 1983 | F | 3/30/84 | Delta | |
| 102,983 | BKO-74 | 1983 | F | 3/30/84 | Delta | |
| 102,984 | BKO-75 | 1983 | F | 3/30/84 | Delta | |
| 102,985 | BKO-79 | 1983 | F | 3/30/84 | Delta | |
| 102,986 | BKY-49 | 1983 | F | 3/30/84 | Delta | Killed ca. 4/5/84 |
| 102,987 | BKO-71 | 1983 | F | 3/30/84 | Delta | |
| 102,988 | BKO-78 | 1983 | F | 3/30/84 | Delta | |
| 102,989 | BKO-72 | 1983 | F | 3/30/84 | Delta | |
| 102,990 | BKO-70 | 1983 | F | 3/30/84 | Delta | |
| 102,991 | BKO-67 | 1983 | F | 3/30/84 | Delta | |
| 102,992 | BKO-77 | 1983 | F | 3/30/84 | Delta | |
| 102,993 | BKY-50 | 1983 | F | 3/30/84 | Delta | |
| 102,994 | BKY-49 | 1983 | M | 3/30/84 | Delta | |

[a] Each caribou was assigned an accession number which remained unchanged even when recollared.

[b] YR = yellow numbers on red collar; BKY = black numbers on yellow collar; BY = blue numbers on yellow collar; BKO = black numbers on orange collar.

Table 2. Down times and body measurements of 12 female calf caribou from the Delta Herd radio-collared on 30 March 1984.

| Accession No. | Collar No. | Telonics ident. | Down time (min) | Recovery time (min) | Wt. (kg) | Neck (cm) | Heart girth (cm) | Tail length (cm) | Hind foot (cm) | Meta-tarsal (cm) | Shoulder height (cm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 102,982 | BKO-76 | 9513 | 8/10 | 6-10 | 59.1 | 37 | 91 | 171 | 53 | 37 | -- |
| 102,983 | BKO-74 | 16618 | 5 | 6-10 | 59.1 | 41 | 99 | 157 | 53 | 38 | 91 |
| 102,984 | BKO-75 | 16617 | 3 | 6-10 | 59.1 | 40 | 98 | 154 | 53 | 38 | 90 |
| 102,985 | BKO-79 | 16632 | 4 | 6-10 | 54.6 | 39 | 96 | 163 | 53 | 37 | -- |
| 102,986 | BKY-49 | 12141 | 5 | 6-10 | 56.8 | 37 | 93 | 168 | 54 | 38 | -- |
| 102,987 | BKO-71 | 16630 | 14 | 6-10 | 55.9 | 42 | 102 | 157 | 51 | 37 | -- |
| 102,988 | BKO-78 | 16619 | 12 | 6-10 | 61.4 | 38 | 98 | 164 | 53 | 38 | 85 |
| 102,989 | BKO-72 | 16616 | --[a] | -- | 60.0 | -- | 99 | -- | -- | -- | -- |
| 102,990 | BKO-70 | 16615 | 6 | 6-10 | 61.4 | 37 | 103 | 165 | 54 | 39 | -- |
| 102,991 | BKO-67 | 16624 | 4 | 6-10 | 61.4 | 37 | 94 | 179 | 54 | 38 | 117 |
| 102,992 | BKO-77 | 16622 | est. 5 | 6-10 | 59.1 | 39 | 97 | 171 | 55 | 38 | -- |
| 102,993 | BKY-50 | 12138 | 5 | 6-10 | 57.3 | 39 | 96 | 162 | 53 | 38 | -- |
| Means | | | 6.8 | | 58.8 | 38.7 | 97.1 | 164.6 | 53.1 | 37.7 | 95.8 |
| Standard Deviation | | | 3.5 | | 2.2 | 1.7 | 3.5 | 7.3 | 0.9 | 0.7 | 14.4 |

[a] Never went down; physically restrained for collaring.

Table 3. Stages of eruption of incisiform teeth of 10-month-old female Delta caribou captured 30 March 1984.

| Accession No. | i1 | | i2 | | i3 | | c1 | |
|---|---|---|---|---|---|---|---|---|
| | R | L | R | L | R | L | R | L |
| 102,982 | D | D | D | D | D | D | D | D |
| 102,983 | P | P | E | A | D | D | D | D |
| 102,984 | D | D | D | D | D | D | D | D |
| 102,985 | D | D | D | D | D | D | D | D |
| 102,986 | D | D | D | D | D | D | D | D |
| 102,987 | (No data) | | | | | | | |
| 102,988 | A | A | D | D | D | D | D | D |
| 102,989 | D | A | D | D | D | D | D | D |
| 102,990 | D | D | D | D | D | D | D | D |
| 102,991 | E | E | D | D | D | D | D | D |
| 102,992 | E | D | D | D | D | D | D | D |
| 102,993 | P | E | D | A | D | D | D | D |
| 102,994[a] | E | E | D | D | D | D | D | D |

[a] Male calf captured April 13, 1984.

D = deciduous, P = permanent, E = erupting, A = absent.

Table 4. Sex and age composition of Alaska's Delta Caribou Herd, 1969-84.

| Date | Bulls: 100 cows | Yrlg: 100 cows | Calves: 100 cows | Yrlg % in herd | No. yrlg | Calf % in herd | No. calves | Cow % in herd | No. cows | Bull % in herd | No. bulls | Sample size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/13-15/69 | 40 | 21 | 28 | 11 | 85 | 15 | 116 | 53 | 410 | 21 | 166 | 777 |
| 10/21-23/70 | 77 | 23 | 34 | 9 | 88 | 14 | 129 | 42 | 383 | 33 | 296 | 896 |
| 10/29-11/1/71 | 29 | 11 | 16 | 7 | 78 | 9 | 109 | 64 | 738 | 18 | 214 | 1,139 |
| 10/27-31/72 | 32 | 6 | 10 | 4 | 46 | 7 | 85 | 67 | 795 | 21 | 259 | 1,185 |
| 10/23-24/73 | 28 | 4 | 10 | 3 | 29 | 7 | 76 | 70 | 735 | 20 | 210 | 1,050 |
| 10/23-25/74 | 27 | 2 | 2 | 1 | 16 | 1 | 17 | 76 | 868 | 21 | 240 | 1,141 |
| 6/11-12/75 | 3 | <1 | 12 | <1 | 3 | 11 | 108 | 86 | 839 | 2 | 26 | 976 |
| Fall 1975 | No counts conducted | | | | | | | | | | | |
| 6/3/76 | 1 | -- | 41 | -- | -- | 28 | 395 | 70 | 955 | 1 | 15 | 1,365 |
| 6/6-22/76 | 1 | -- | 55 | -- | -- | 35 | 390 | 63 | 699 | 0 | 10 | 1,099 |
| 10/29-11/1/76 | 38 | 1 | 45 | <1 | 5 | 24 | 258 | 54 | 572 | 20 | 220 | 1,055 |
| 6/16-19/77 | 9 | 12 | 34 | 8 | 95 | 22 | 269 | 64 | 784 | 6 | 76 | 1,224 |
| 10/26-11/2/77 | 32 | 6 | 42 | 3 | 44 | 23 | 319 | 55 | 756 | 18 | 246 | 1,365 |
| 6/13-14/78 | 12 | 8 | 23 | 6 | 52 | 16 | 157 | 69 | 661 | 8 | 81 | 951 |
| 10/26/78 | 75 | 10 | 39 | 5 | 33 | 17 | 126 | 44 | 324 | 33 | 242 | 725 |
| 6/23/79 | 11 | 18 | 44 | 10 | 76 | 25 | 189 | 57 | 424 | 6 | 49 | 738 |
| 12/7/79 | 39 | -- | 65 | -- | -- | 32 | 115 | 49 | 177 | 19 | 69 | 361 |
| 6/14/80 | 18 | -- | 43 | -- | -- | 26 | 324 | 61 | 748 | 11 | 137 | 1,209 |
| 10/15-11/3/80 | 85 | -- | 49 | -- | -- | 21 | 288 | 42 | 585 | 36 | 496 | 1,369 |
| 6/17/81 | 12 | 16 | 33 | 9 | 87 | 21 | 182 | 62 | 543 | 8 | 68 | 880 |
| 10/2/81 | 59 | -- | 41 | -- | -- | 20 | 319 | 50 | 776 | 29 | 458 | 1,553 |
| 5/23/82 | -- | -- | 72 | -- | -- | 42 | 108 | 58 | 151 | 0 | 0 | 259 |
| 10/8/82 | 54 | -- | 29 | -- | -- | 16 | 215 | 55 | 736 | 30 | 398 | 1,349 |
| 11/26/82 | 60 | -- | 38 | -- | -- | 19 | 65 | 51 | 173 | 30 | 104 | 342 |
| 11/26/82[a] | 59 | -- | 36 | -- | -- | 18 | 56 | 51 | 156 | 30 | 92 | 304 |
| 4/20/83 | 23 | -- | 29 | -- | -- | 19 | 205 | 66 | 708 | 15 | 166 | 1,079 |
| 6/15/83 | 4 | -- | 51[b] | -- | -- | 33 | 522 | 64 | 1,021 | 3 | 44 | 1,587 |
| 10/4/83 | 54 | -- | 46 | -- | -- | 23 | 307 | 50 | 665 | 39 | 139 | 1,333 |
| 4/10/84 | 10 | -- | 49 | -- | -- | 31 | 194 | 63 | 396 | -- | -- | 628 |

Table 4. Continued.

| Date | Bulls: 100 cows | Yrlg: 100 cows | Calves: 100 cows | Yrlg % in herd | No. yrlg | Calf % in herd | No. calves | Cow % in herd | No. cows | Bull % in herd | No. bulls | Sample size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/13/84[b] | 22 | -- | 44 | -- | -- | 26 | 44 | 60 | 101 | -- | -- | 167 |
| 5/20/84 | -- | -- | 82[c] | -- | -- | -- | -- | -- | 482 | -- | -- | 877 |
| 6/22/84 | 17 | -- | 56 | -- | -- | 32 | 837 | 58 | 1,508 | -- | -- | 2,604 |
| 10/17/84 | 42 | -- | 36 | -- | -- | 20 | 222 | 56 | 613 | 24 | 258 | 1,093 |

[a] Yanert Herd.

[b] Yearlings were not segregated.

[c] 82 calves:100 cows is a maximum ratio as it is actually 82% cows with calf or still pregnant (Bergerud and Butler data).

Table 5. Reproductive history of radio-collared female caribou from the Delta and Yanert Herds, 1979-84.

| Accession No. | Collar No.[a] | Year collared | Year of birth | Produced a calf | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | |
| 101,972 | BKY-36 | 1979 | 1978 | No | Yes | Yes | Yes | Yes | -- | Died |
| 101,973 | BKY-28 | 1979 | 1978 | No | No | Yes | No | Yes | Yes | |
| 101,974 | BKY-37 | 1979 | 1978 | No | Yes | Yes | Yes | Yes | Yes | |
| 101,977 | BKY-49 | 1979 | 1978 | No | No | Yes | -- | -- | -- | Died |
| 101,981 | BKY-20 | 1979 | 1978 | No | Yes | No | -- | -- | -- | Died |
| 101,982 | BKY-78 | 1979 | 1978 | No | Unk | No | No | No | No | |
| 101,984 | BKY-47 | 1979 | 1978 | No | Yes | Yes | No | Yes | Yes | |
| 101,988 | BKY-25 | 1979 | 1978 | No | No | No | Yes | Yes | Yes | |
| 101,993 | BKY-26 | 1979 | 1978 | No | Unk | Yes | Yes | Yes | Yes | |
| 101,994 | YR-79 | 1979 | 1978 | No | Yes | Yes | -- | -- | -- | Radio failed |
| 101,997 | BKY-20 | 1979 | 1978 | No | Yes | Yes | Yes | No | Yes | |
| 102,341 | BKY-15 | 1981 | 1980 | -- | -- | No | No | Yes | Yes | |
| 102,343 | BKY-13 | 1981 | 1980 | -- | -- | Unk | No | Yes | Yes | |
| 102,348 | BKY-14 | 1981 | 1980 | -- | -- | No | No | Yes | Yes | |
| 102,349 | BKY-12 | 1981 | 1979? | -- | -- | Yes | Unk | Yes | Yes | |
| 102,350 | BKY-22 | 1981 | 1978? | -- | -- | Yes | Yes | Yes | Yes | |
| 102,360 | BKY-16 | 1981 | 1980 | -- | -- | No | No | Yes | Yes | |
| 102,362 | BKY-18 | 1981 | pre-1978 | -- | -- | Yes | Yes | Yes | Yes | |
| 102,363 | BKY-29 | 1981 | pre-1979 | -- | -- | Yes | No | No | Yes | Yanert Herd |
| 102,364 | BKY-30 | 1981 | pre-1980 | -- | -- | No | Yes | Yes | Yes | Yanert Herd |
| 102,365 | BKY-31 | 1981 | pre-1979 | -- | -- | Yes | Yes | Yes | Yes | Yanert Herd |
| 102,366 | BKY-32 | 1981 | pre-1979 | -- | -- | -- | -- | -- | -- | Not seen since collaring |
| 102,367 | BKY-33 | 1981 | pre-1980 | -- | -- | Yes | Yes | Yes | Yes | Yanert Herd |
| 102,368 | BKY-34 | 1981 | pre-1979 | -- | -- | Yes | Yes | Yes | Unk | Yanert Herd |
| 102,369 | BKY-35 | 1981 | pre-1979 | -- | -- | Yes | Yes | Yes | Yes | Yanert Herd |

Table 5. Continued.

| Accession No. | Collar No.[a] | Year collared | Year of birth | Produced a calf 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 102,370 | BKY-70 | 1981 | pre-1979 | -- | -- | Yes | Yes | No | Yes | Yanert Herd |
| 102,430 | BKY-19 | 1981 | 1980 | -- | -- | No | No | Yes | Unk | Not found in May 1984 |
| 102,431 | BKY-23 | 1981 | 1980 | -- | -- | No | No | Yes | Yes | |
| 102,432 | BKY-27 | 1981 | 1980 | -- | -- | No | No | Yes | Yes | |
| 102,546 | BKY-9 | 1982 | 1981 | -- | -- | -- | No | No | -- | Died |
| 102,547 | BKY-10 | 1982 | 1981 | -- | -- | -- | -- | -- | -- | Died |
| 102,548 | BKY-7 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,549 | BKY-6 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,560 | BKY-1 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,561 | BKY-4 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,562 | BKY-2 | 1982 | 1981 | -- | -- | -- | No | Yes | Yes | |
| 102,563 | BKY-5 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,564 | BKY-3 | 1982 | 1981 | -- | -- | -- | No | -- | -- | Died |
| 102,565 | BKY-0 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,566 | BKY-8 | 1982 | 1981 | -- | -- | -- | No | No | Yes | |
| 102,803 | BKY-40 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,804 | BKY-43 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,805 | BKY-41 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,806 | BKY-42 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,807 | BKY-39 | 1983 | 1982 | -- | -- | -- | -- | -- | -- | Died |
| 102,808 | BKY-48 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,809 | BKY-10 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,810 | BKY-45 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,811 | BKY-44 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,812 | BKY-17 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |

Table 5. Continued.

| Accession No. | Collar No.[a] | Year collared | Year of birth | Produced a calf 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 102,814 | BKY-46 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |
| 102,815 | BKY-3 | 1983 | 1982 | -- | -- | -- | -- | -- | No | |

[a] BKY = black numbers on yellow collar; YR = yellow numbers on red collar, BKO = black numbers on orange collar.

Table 6. Estimates of population size of Alaska's Delta and Yanert (Delta/Yanert) Herds, 1973 and 1979-84. (Note: census methodology varied in many years, which must be considered for between-year comparisons.)

| | Delta Herd only | | | | |
|---|---|---|---|---|---|
| Year | Caribou counted in postcalving aggregations comprising primarily cows and calves | Extrapolated number of females older than calves | Extrapolated APDCE census estimate | Caribou counted in Yanert Herd | Estimate of Delta and Yanert Herds combined |
| 1973 | 2,088-2,288 | 1,585-1,737 | 2,198-2,409 | No data (assumed 500) | 2,804 |
| 1979 | 2,931 | 1,817 | 3,700-3,961 | No data (assumed 500) | 4,191 |
| 1980 | 3,127 (+58 cows) | 1,949 | 4,194-4,448 | No data (assumed 500) | 4,478 |
| 1981 | 3,426-4,002 | 2,090-2,441 | 4,180-5,320 | 431 | 4,962 |
| 1982 | 5,679 | 3,464 | 6,298-6,792 | 790 | 7,335 |
| 1983 | 4,719 | 3,020 | 6,040-6,300 | 929 | 6,969 |
| Fall recount adjusted for harvest = | | | 6,300 | Assumed 500-929 | 6,800-7,229 |
| 1984 | 5,483 | 3,180 | 6,260 | Not applicable | 6,260 |

Table 7. Harvest of Delta caribou 1968-84.[a]

| Year | Males n (%) | Females n (%) | Sex unk n (%) | Total | Extrapolated total |
|---|---|---|---|---|---|
| 1968-69 | 119(81) | 25(17) | 3(2) | 147[b] | 160 |
| | -- | -- | -- | 205[c] | NA |
| 1969-70 | 169(75) | 54(24) | 2(1) | 225 | 324 |
| 1970-71 | 198(72) | 68(25) | 9(3) | 275 | 428 |
| 1971-72 | 387(62) | 226(36) | 12(2) | 624 | 740 |
| 1972-73 | 372(72) | 132(25) | 13(3) | 517 | NA |
| 1973-74 | 158(70) | 67(30) | 8 | 233 | 301 |
| 1974-75 through 1979-80, no open season | | | | | |
| 1980-81 | 104(100) | | | 104 | |
| 1981-82 (fall) | 78 | 9 | | 87 | |
| 1981-82 (winter) | 113 | 64 | 4 | 181 | |
| 1981-82 (total) | 191 | 73 | 4 | 268 | |
| 1982-83 (fall) | 92 | 11 | 1 | 104 | |
| 1982-83 (winter) | 101 | 65 | 3 | 169 | |
| 1982-83 (total) | 193 | 76 | 4 | 273 | |
| Delta 1983-84 | 576 | 98 | 20 | 694 | |
| Yanert 1983-84 | 40 | 12 | 2 | 54 | |

[a] Harvest from Subunit 20A and part of 20C.

[b] From 1969 Alaska Department of Fish and Game Survey and Inventory Progress Report.

[c] From J. Sexton memo 3 December 1970.

Table 8. Hunting seasons and bag limits for Delta caribou, 1968-84.[a]

| Year | Season | Bag limit |
|---|---|---|
| 1968-69 | 10 Aug-31 Mar | 3 caribou |
| 1969-70 | 10 Aug-31 Mar | 3 caribou |
| 1970-71 | 10 Aug-31 Mar | 3 caribou |
| 1971-72 | 10 Aug-31 Mar | 3 caribou |
| 1972-73 | 10 Aug-31 Mar | 3 caribou |
| 1973-74[b] | 10 Aug-31 Dec | 1 caribou |
| 1974-75[c] | 10 Aug-20 Sep | 1 caribou |
| 1975-76 through 1979-80 | No open season | |
| 1980-81 | 1 Sep-30 Sep | 1 male by drawing permit. 200 permits issued. |
| 1981-82 | 10 Aug-30 Sep<br>15 Nov-31 Dec | 1 caribou by drawing permit from 10 Aug-30 Sep; 150 permits issued, up to 25 will be issued to nonresidents. Antlered caribou may be taken from 15 Nov-31 Dec by registration permit. A total of 400 caribou may be taken. |
| 1982-83 | 10 Aug-30 Sep<br>1 Dec-31 Mar | 1 caribou by drawing permit from 10 Aug-30 Sep; 175 permits issued, up to 30 will be issued to nonresidents. Antlered caribou may be taken from 1 Dec-31 Mar by registration permit. A total of 500 caribou may be taken. |

Table 8. Continued.

| Year | Season | Bag limit |
|---|---|---|
| 1984-85[e,f] | 20 Aug-20 Sep | 1 caribou by registration permit only. 600 caribou may be taken. The 20 Aug-20 Sep season will be closed when 300 caribou have been taken; the 1 Feb-31 Mar season will be closed when the total harvest reaches 600 caribou. |
| | 10 Aug-31 Mar | 1 caribou. |

[a] Subunit 20A and part of 20C.

[b] Amended by emergency announcement to close 20 September.

[c] Amended by emergency announcement to No Open Season.

[d] Amended by emergency announcement to close 28 October, except the Yanert River drainage which remained open through 31 March.

[e] Amended by emergency announcement to close 5 September, except the Yanert River drainage.

[f] Amended by emergency announcement to close the Yanert River drainage on 8 February 1985.

APPENDIX A. Citations of publications contributed to by this study, P-R Project W-21-2, W-22-1, W-22-2, W-22-3, and W-22-4, Job 3.27R.

Alaska Department of Fish and Game. 1983. The Delta Caribou Herd, 1950 through 1982: Caribou-Wolf Relationships. Info. Leafl. Juneau. 4pp.

Davis, J. L., P. Valkenburg, and R. D. Boertje. 1983. Demography and limiting factors of Alaska's Delta Caribou Herd, 1954-1981. Acta Zool. Fennica 175:135-137.

_____, _____, and _____. 1985. Disturbance and the Delta Caribou Herd. Pages 2-6 in Martell, A.M.; Russell, D.E. eds. Caribou and human activity. Proc. 1st North Am. Caribou Workshop, Whitehorse, Yukon, 28-29 Sept. 1983. Can. Wildl. Serv. Spec. Publ., Ottawa.

Gasaway, W. C., R. O. Stephenson, and J. L. Davis. 1983. Wolf-Prey Relationships in Interior Alaska. Alaska Dep. Fish and Game. Wildl. Tech. Bull. No. 6. Juneau. 15pp.

_____, _____, _____, P. E. K. Shepherd, and O. E. Burris. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. Wildl. Monogr. 84. 50pp.

Valkenburg, P., and J. D. Davis. 1985. The reaction of caribou to aircraft: a comparison of two herds. Pages 7-9 in Martell A.M.; Russell, D.E. eds. caribou and human activity. Proc. 1st North Am. Caribou Workshop, Whitehorse, Yukon, 28-29 Sept. 1983. Can Wildl. Serv. Spec. Publ., Ottawa.

_____, R. D. Boertje, and J. L. Davis. 1983. Effects of darting and netting on caribou in Alaska. J. Wildl. Manage. 47(4):1233-1237.

_____, D. A. Anderson, J. L. Davis, and D. J. Reed. 1985. Evaluation of an aerial photocensus technique for caribou based on radiotelemetry. Proc. 2nd North Am. Caribou Workshop. Val Morin, Quebec, 17-20 Oct. 1984.

APPENDIX B. Abstract of a paper to be presented at the 4th International Reindeer/Caribou Symposium, Whitehorse, Yukon in August 1985.

CALVING GROUND FIDELITY AND HERD IDENTITY OF THE DELTA AND YANERT CARIBOU, ALASKA. J. L. Davis, P. Valkenburg, and R. D. Boertje, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701.

A single traditional calving area was delineated for the Delta Herd based on results of aerial surveys conducted from the 1950's through 1983 and radio telemetry studies from 1979 through 1983. Relocations of radio-collared caribou from both the Delta and Yanert Herds, from 1979 through 1983, indicated that these 2 herds maintained discrete calving areas, even though significant intermixing occurred during other seasons. However, during calving in 1984, 5 of 25 radio-collared Delta cows $\geq$3 years old and 5 of 24 radio-collared Delta cows <3 years old were located in the calving area of the adjacent Yanert Caribou Herd 72 km west-southwest of the traditional Delta calving area. The cow-calf segments of both herds were totally intermixed during the postcalving period in 1984. Implications of these observations are discussed in relation to: (1) The conventional model of herd identity proposed by Skoog, and (2) Bergerud's concept of optimal and dynamic use of space.

APPENDIX C. Location, size, and composition of postcalving aggregations during the censuses of the Delta and Yanert Caribou Herds, 21 and 22 June 1984 (see Fig. 3).

| Group No. | Number counted | Composition |
|---|---|---|
| 1 | 159 | Mixed |
| 2 | 152 | Mixed |
| 3 | 378 | Mixed |
| 4 | 223 | Mixed |
| 5 | 298 | Mixed |
| 6 combined 7 | 200 | Mixed |
| 8 | 604 | Mixed |
| 9 | 119 | Mixed |
| 10 | 746 | Mixed |
| 11 | 55 | Mixed |
| 12 | 155 | Mixed |
| 13 | 262 | Mixed |
| 14 | 647 | Mixed |
| 15 | 455 | Mixed |
| 16 | 90 | Mixed |
| 17 | 359 | Mixed |
| 18 | 47 | Mixed |
| 19 | 44 | Mixed |
| 20 | 120 | Mixed |
| 21 | 118 | Mixed |
| 22 | 108 | Mostly males |
| 23 | 436 | Mostly males |
| Subtotal | 5,775 | |
| Number counted visually | 452 | (includes 200 bulls) |
| Total | 6,227 | |