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

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Period Covered: 1 July 1982 through 30 June 1983 (including data through November 1983)

SUMMARY

During this reporting period, we radio-collared and obtained morphometric and physiological data from 13 Delta Herd caribou (Rangifer tarandus granti). Twelve of the caribou captured were 10-month-old females, which makes a total of 37 known-aged females radio-collared in the Delta Herd. The immobilizing dose of 5 mg acepromazine plus 4.5 mg etorphine was an improvement over past doses of 5 mg etorphine or 4.8 mg etorphine plus 20-30 mg Rompun. The mean live weight of the 12, 10-month-old female caribou captured in 1983 was not significantly different (Student's t, $P > 0.1$ for each year) than the mean weight of caribou from the 3 previous cohorts at comparable age.

The peak of calving was about 21 May in 1983. Calf production remained high with 80 calves:100 caribou older than calves noted on the core calving areas. By 15 June 1983, a ratio of 51 calves:100 females older than calves was observed.

Movements and distribution of radio-collared Delta Herd caribou were similar to past years, and data from 1979 through the present were summarized and appear in Appendix A. The role of disturbance on the Delta Caribou Herd was reviewed. Two papers about disturbance (Disturbance and the Delta Caribou Herd; The Reaction of Caribou to Aircraft: A comparison of 2 herds) were presented at the 1st North American Caribou Workshop in Whitehorse, Yukon (28-29 Sep 1983) and appear as Appendices C and D.

Censuses of the Delta and Yanert Caribou Herds were conducted on 14-15 June 1983. The Delta Herd was estimated to number 5,425, and the Yanert Herd numbered 929. Projections from 1982 for the Delta Herd suggested that the Delta Herd should have numbered over 7,000 in 1983. The lower estimate from the census cannot be

adequately explained, but it appears that a portion of the herd was not located during the June 1983 census. After an estimated harvest of over 1,000 Delta caribou in fall 1983, a 1-day census of caribou associated with radio-collared Delta caribou produced an estimate of 5,300 on 4 October 1983.

There is limited evidence that herd recruitment in 1982-83 was lower than the preceding 5-year mean. Natural mortality rates appeared higher in 1983.

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

CONTENTS

BACKGROUND

Davis and Neiland (1975) reviewed and compiled all available data for the Delta Caribou (Rangifer tarandus granti) Herd (DCH) in 1974. Additional background information was presented by Davis and Preston (1980), Davis and Valkenburg (1981, 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 Unit 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 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 incidentally 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 for this progress report. 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.

PROCEDURES

Study Area

The study area (Fig. 1) included the range of the DCH and the Yanert Caribou Herd (Davis and Valkenburg 1983). In this report, all reference to the DCH prior to 1980 includes the Delta and Yanert Herds.

Radio-collaring/Morphometry/Physiology

From 1 July 1982 through 30 June 1983, we captured, radio-collared, and obtained morphometric and physiological data from 13 caribou. All except 1 were 10-month-old females, and all were captured on 1 April 1983. There are now 37 known-aged females, from 4 separate cohorts, radio-collared within the range of the DCH. In addition, there are 3 female and 1 male Delta caribou with active radio collars, but whose age is known only by estimate from cementum annuli of an incisiform canine tooth (Miller 1974).

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 (M99, D-M Pharmaceuticals, Inc., Rockville, Md.).

Radio collars were constructed of triple-layered, rubberized machine belting to which a hermetically sealed metal box containing the transmitter and batteries was attached. 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.) Normal pulse frequency was approximately 60 beats/min. When movement ceased for approximately 4 hours, the pulse doubled or tripled.

Relocating Radio-collared Caribou

Radio-collared caribou were relocated from fixed-wing aircraft (Bellanca Scout and Piper Super Cub) equipped with 2 "H" antennas (Telonics Inc., Mesa, Ariz.). We used a Telonics Inc. radio receiver/scanner and monitored some or all of the radio-collared caribou during 18 flights (Table 1). We also received some reports from the public on the locations of collared caribou, and 1 hunter returned the collar of a caribou he shot. We tried to observe the radio-collared caribou during each relocation. During each sighting, we recorded 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.

All radio collars were equipped with movement sensitive mortality switches that enabled us to audibly determine if a radio-collared caribou had died. We investigated the cause of death of all dead caribou found, including those without radio collars.

Calving/Productivity/Recruitment

Calving distribution, success, and chronology of the Delta and Yanert Herds were monitored by fixed-wing surveys of radio-collared and associated caribou on 6 days in late May (Table 1). 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 Delta Herd'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 (Table 2) using a helicopter to classify caribou from the air, supplemented by classification from the ground using a 20X-60X spotting scope.

Herd Identities

Movements of the Delta and Yanert Herds were monitored to determine if any interactions or interchange occurred between the neighboring Macomb, Denali, and Nelchina Herds. This effort was complemented by continuing studies of the other herds, particularly the Nelchina caribou (Pitcher 1983) and Macomb Herd (D. Johnson, Alaska Dep. Fish and Game files).

Delta and Yanert Censuses

The modified aerial photo-direct count-extrapolation (APDCE) census procedure (Davis et al. 1979) was used during the 1983 Delta Herd and Yanert Herd censuses. 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.

The Delta and Yanert Herds 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 by a DeHavilland Beaver with a belly-mounted 9 x 9 inch Fairchild T-11 aerial camera using black and white Kodak XX Aerographic film (ASA 125). Some of the smaller aggregations were photographed with 35mm 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 Delta Herd in 1982) using a Bellanca Scout for the reconnaissance, and they visually counted and/or photographed (with 35mm SLR cameras) all caribou associated with the radio-collared caribou. We subsequently learned that 2 of the 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.

Harvest

Harvest figures for 1983 were not available by the end of the reporting period. Harvest was subjectively estimated by L. Jennings based on contacts with local air taxi pilots, hunters, and observations of Fish and Wildlife Protection Officers and Department biologists.

Natural Mortality and Population Dynamics

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 1981, 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. However, we know of no better estimator of mortality rates.

RESULTS

Radio-collaring

Twelve caribou were radio-collared during this reporting period, and 1 additional caribou was captured but not radio-collared (Table 3). At the end of this reporting period, we had 7 Yanert caribou (all adult females) and 38 Delta caribou (1 adult male, 26 adult females, and 11 yearling females) with functioning radio collars.

Immobilizing Caribou

Davis and Valkenburg (1983) concluded that a larger dose of M99 than they had been using, or a better immobilizing drug than M99 or M99 plus Rompun, was needed for immobilizing Alaskan caribou--primarily because of unsatisfactorily long drug induction time or incomplete immobilization. The combination of acepromazine and M99 used in 1983 seemed to be a vast improvement. Drug induction times were recorded for 11 of the 12, 10-month-old caribou immobilized in 1983. Induction time ranged from 3 to 18 min ($\bar{x}$ = 7.2 ± 4.8), and all caribou were satisfactorily immobilized (Table 4). In contrast, in 1982 11, 11-month-old caribou were immobilized using 4.8 mg of M99 plus 20 mg Rompun, immobilization time ranged from 11 to 40 min ($\bar{x}$ = 21.0 ± 11.7), and only 4 caribou were satisfactorily immobilized. The others were caught and physically restrained. There was no significant difference in body weights between the groups handled in 1982 and 1983.

In 1983, a 22-month-old female was darted inadvertently and released after being ear-tagged.

Morphometry/Physiology

The mean live weight of the 12, 10-month-old female caribou captured in 1983 was not significantly different (Student's t, $P > 0.1$ for each year) than the mean weight of caribou from the 3 previous cohorts at comparable age (Table 5).

Sera and whole blood samples were collected from all caribou captured in 1983. Data from analysis of the blood will appear in the final report.

Eruption patterns of incisiform teeth were recorded for all the 10-month-old caribou (Table 6), and there was a direct correlation between body weight and advanced eruption of permanent teeth.

Relocating Radio-collared Caribou

Relocations of all caribou collared since 1979 were plotted on maps (Appendix A), and generalized movement patterns noted. More thorough analysis and discussion of movements and distribution will appear in the final report.

During winter 1982-83, most of the DCH occupied the area west of Wood River, and only a few had moved east of the Wood River by the end of March when the hunting season closed. This trend of increased wintering in the extreme western portion of the herd's range has been consistent since the herd began increasing in the mid-1970's. Prior to the DCH's decline in the early 1970's, caribou annually wintered in the Nenana River valley, but it was never documented if these wintering caribou were Delta or McKinley (Denali) caribou or both.

A 2nd trend in movements seems apparent since the herd began increasing after 1976. In the early 1970's, most postcalving aggregations remained in the traditional calving area east of the East Fork of Little Delta River until after mid-June. Since 1977, these postcalving aggregations have been distributed farther to the west (in the vicinity of the West Fork of Little Delta River) by mid-June.

During much of the fall hunting season in 1983, distribution and movements of the DCH made it possible for hunters to see hundreds of caribou within a few days and to be selective. In mid-August, the herd was widely distributed, but many caribou were available to hunters along the Liberty Bell Mine Trail near Ferry. In late August, caribou moved east along the foothills as far as Iowa Ridge, then turned west again in early September. Many caribou reached the Totatlanika River by 9 September before abruptly turning east again on the 10th. They apparently traveled east to the Little Delta River in September, then turned west again about the 20th. Rutting occurred largely west of the Totatlanika River, and when the caribou were censused on 4 October, most were approaching the Nenana River and still apparently moving west. During late October, we received reports of caribou in the Healy area and of some caribou crossing the Parks Highway. However, when we next located the collared caribou on 9 November, most had moved to the vicinity of Iowa Ridge, where all but 2 of the radio-collared caribou were found.

Calving Chronology and Distribution

It appears that the calf:cow ratio peaked on 21 May 1983 (Fig. 2) or shortly thereafter in the DCH. On 21 May, 24% of 543 adult caribou observed on the calving grounds were antlerless and 80 calves:100 caribou older than calves were observed on the core calving areas. Almost all of the caribou older than calves were adult females, but a few were undoubtedly yearlings.

Monitoring radio-collared cows suggested a similar or slightly earlier calving peak. We began monitoring radio-collared caribou on 18 May and continued checking females that had not yet been seen with a calf every other day until 31 May. On 19 May, 9 of 12 pregnant (determined by distended udders) radio-collared Delta caribou were accompanied with newborn calves, and 10 of these still retained hard antlers. Of 13 pregnant radio-collared Delta caribou observed on 21 May, 9 were accompanied with newborn calves.

In 1983, calving in the DCH occurred primarily in the same areas as in past years (excepting 1982). By far, most calving females were observed in the traditional core calving areas (Fig. 3) east of the East Fork of Little Delta River. West of there, more nonpregnant females, yearlings, and males were present. Only 2 DCH males had active radio collars during calving time in 1983. One was on the upper Tatlanika River on 18 May; the other was near Dry Creek.

No composition surveys were conducted in the Yanert Herd's range during the calving period in 1983. However, we did monitor radio-collared Yanert caribou from 19 May to 29 May. Of the 8 females collared in 1981, 1 was never relocated, and 1 (BKY 34) has been associated with the Delta Herd since fall 1982. Four of the other 6 were relocated on 19 May 1983, and 2 were not pregnant. One of the pregnant females was accompanied by a calf on 19 May, but the other was not. The other 2 radio-collared Yanert caribou were relocated on 27 and 29 May, and both were accompanied by calves and retained their hard antlers.

Calving in the Yanert Herd in 1983 was similar to that recorded in the past 2 years. Calving caribou were widely scattered in the high mountains (1,500-2,200 m) between the upper Wood and Yanert Fork Rivers. All radio-collared cows calved at the heads of Dick, Edgar, Big Grizzly, and Little Grizzly Creeks.

Productivity/Natality

In 1983, only 1 of 9 radio-collared 2-year-olds produced a calf (Table 7) on its 2nd birthday. This was similar to 1982 when none of the 7 radio-collared 2-year-olds reproduced. In contrast, a majority of the females born in 1978 produced calves in 1980 (Tables 7, 8). Possible reasons for this variation in productivity in 2-year-olds were discussed previously (Davis and Valkenburg 1983).

Natality among female radio-collared Delta caribou 36 months old and older has averaged 81% (weighted annual mean) (34/42 females) from 1979 through 1983. In 1982, the natality rate of radio-collared female Delta caribou older than 2 years was 70% (7/10), and in 1983 the rate was 87% (13/15). This difference is not statistically significant (chi-square = 1.04, 1 df, $0.40 > \underline{P} > 0.30$).

Even though reproduction by 2-year-old cows seems to have essentially ceased since 1980, overall herd productivity has remained at a high level. As noted above, calf production on the core calving areas was 80 calves:100 caribou older than calves in 1983 and for all calving caribou (Fig. 3) a ratio of 75 calves:100 adults not including obvious bulls and yearlings was observed. By 15 June, a ratio of 51 calves:100 females older than calves was observed. From these above ratios, it is clear that herd productivity is high and early postnatal mortality of calves is relatively low.

Recruitment

Recruitment continues to be an important parameter that is particularly difficult to accurately measure. We normally consider recruitment to be the rate of breeding stock replacement. Because the only way to accurately measure recruitment entails measuring changes in absolute numbers of various cohorts over time, we normally resort to estimating recruitment from 1 or more indices. Most frequently, the percentage of calves in a population becomes the index for estimating recruitment.

Several major assumptions are inherent in estimating recruitment from the proportion of calves in the herd. Because barren-ground caribou are socially segregated based on sex and age most of the year, it is generally assumed that the rut is the only time the herd is homogenously mixed, and that a representative sample of true herd sex and age structure can be obtained then. Davis et al. (1979) have demonstrated that this assumption may often be invalid, but a more reliable method of consistently and efficiently determining true herd composition has not been discovered.

To estimate survival of the calf cohort from rut (when the assumed valid calf percent of herd figure is obtained) to when the cohort becomes 1 year old (i.e., overwinter survival), a comparison of calf:cow ratios between rut and spring is made. Assumptions implicit in this step are that both sets of ratios are representative of the population and that cow mortality is not occurring between rut and late winter or some estimate of the rate of cow mortality must be incorporated into calculations. If yearlings are not considered as breeding stock or if mortality from 12 months to 24 months is different than post-24 months, then these considerations also must be incorporated into calculations.

Davis and Valkenburg (1983) discussed recruitment in the DCH from 1979 through 1982 as follows:

> "Mean calf percentage of the herd in fall is our best available index to recruitment and was $\bar{x}$ = 21.9 ± 5.34 for 1976 through 1982. To calculate the percent increase (from the preceding year) that 21.9% calves in fall represents, a ratio conversion can be used as follows:
>
> $$\frac{21.9}{(100-21.9)} = \frac{x}{100}, \text{ therefore, } x = 28(\%).$$
>
> Thus, a mean of 21.9% calves present in fall represents a mean calf increment from the preceding year of 28%. Davis and Preston (1980) estimated calf survival from October 1978 to May 1979 to be 80-92% (based on radio-collared caribou), and there is no indication it has changed (Davis and Valkenburg 1981a, Davis et al. 1982). The potential 28% increase from calves present in fall can be adjusted to 22.4-25.8% to allow for mortality to yearling age. This then suggests that mortality of caribou yearlings and older should have ranged from a low of 0 to 2.8% up to 4.4 to 7.8% from 1976 through 1982. These results are consistent with the results discussed in the Natural Mortality and Harvest sections of this report."

Composition of the Delta Herd was estimated twice in fall 1982. On 8 October 1982, a sample contained 29 calves:100 females older than calves and a comparable sample on 26 November 1982 was 38:100. Sampling in April 1983 produced a ratio of 29:100. From these ratios, worst and best case scenarios produce overwinter calf survival estimates of 76-100% without correcting for adult mortality. Estimates of female adult natural mortality in the DCH, based on monitoring radio-collared individuals between 1979 and 1983, have ranged from 1.6-6%/year. (These estimates are probably conservative because the radio-collared adults are all less than 6 years old.) Factoring in the worst case adult female mortality of 6%, estimated calf survival for 1982-83 would have been 70-94%.

Using the ratio conversion used in 1982 (Davis and Valkenburg 1983) to calculate the percent increase from the preceding year that a given percent of calves in fall represents for the 1982-83 recruitment year would be as follows:

$$\frac{16 \text{ to } 19}{100-16 \text{ to } 19} = \frac{x}{100}, \quad x = 19 \text{ to } 23.5\% \text{ less overwinter mortality.}$$

Applying the 70-94% survival calculated above, we get estimated yearling age recruitment of 13.3 to 22.1% for the spring 1983 population. These values can be compared to the 1976-82 mean of 22.4-25.8%.

Herd Identities

To be discussed in final report.

Delta and Yanert Censuses

A total of 6,354 caribou were counted in the range of the Delta and Yanert Herds on 15 and 14 June 1983. Of the total, 5,425 were judged to be Delta Herd caribou, and 929 were judged to be Yanert Herd caribou (Appendix B). Attempting to independently census the 2 herds was greatly confounded because practically the entire Delta Herd was distributed in the upper Wood River drainage in an area that is frequently occupied by Yanert caribou. Rapid and continuous movement of aggregations between the Yanert and Wood Rivers further confounded the censuses. There is considerable circumstantial evidence that we may have missed a portion of 1 or both herds during the census because of rapid movements from or between areas assigned to different crews. The caribou were located in extremely mountainous terrain that precluded continuous communication between all survey aircraft and hence some question remains about census coordination.

Because of uncertainties stemming from the June 1983 census, a cursory census was conducted on 4 October 1983.

During the 4 October 1983 census, 5,051 caribou were counted. This was thought to be a conservative count, because only radio-collared individuals, associated caribou, and those found incidentally to radio-tracking were counted. In addition, the helicopter used to conduct composition counts on 4 October located about 100 additional caribou in transit to the aggregations associated with the radio-collared caribou. For these reasons, it seems probable that 5,300 would be a conservative estimate for the Delta Herd in October 1983. All radio-collared Yanert caribou were in the Yanert drainage so it was assumed that the Yanert Herd was not mixed with the Delta Herd during the October census.

Although the 1983 harvest report card data are not yet available, the Department's subjective estimate of harvest is that at least 1,000 caribou were killed between 10 August and 4 October 1983. If the 1,000 harvest is added to the 4 October count of 5,300, then there should have been at least 6,300 Delta caribou in June 1983 when only 5,425 were counted.

Harvest

The 1983-84 hunting season for the Delta and Yanert Caribou Herds was scheduled to run from 10 August 1983 through 31 March 1984, with a bag limit of 1 caribou (Table 9). Because of movements and distribution of the Delta Herd in fall 1983, hunter success was apparently very high and, although harvest report data are not yet available, it appears that over 1,000 caribou were harvested by mid-October 1983.

Based on the apparently large harvest through October, the outlook that the herd would remain relatively available to hunters, and the 1983 censuses producing lower population estimates than projected from 1982, the hunting season for the DCH was closed by emergency order on 28 October 1983 (Table 10). The Yanert Fork drainage remained open.

Natural Mortality and Population Dynamics

Davis and Valkenburg (1983) summarized the population dynamics of the DCH through June 1982, including a discussion of natural mortality rates. Because of the questionable results of the 1983 population censuses, it seems that there is little to gain in discussing recent population dynamics prior to conducting a 1984 census. A couple of considerations do warrant mention, however. Yearling recruitment in 1982-83 may well have been below the preceding 5-year mean: 13-22% in 1982-83 versus 22-26% for 1976 to 1982. In addition, there is limited evidence of increased natural mortality in adult females in 1982-83. The mean annual natural mortality rate of all female Delta caribou radio-collared since the inception of this project in 1979 (January 1979 through October 1983) was 3% per "collared-animal year." From 1979 through October 1982, natural mortality of adult females averaged 1.6% compared to 5.8% from October 1982 through October 1983. Our calculated mortality rates are undoubtedly lower than experienced by the population. Mean age and maximum age of the radio-collared females are undoubtedly much younger than the population as a whole because radio-collared females are all from 1978 or more recent cohorts. In addition, Davis and Valkenburg (1981) presented evidence that natural mortality of males is normally substantially greater than in females.

Two unexpected observations regarding population dynamics were noted in 1983. The projected herd size for 1983 was not substantiated by censusing in 1983. Secondly, the apparently large harvest in 1983 of over 1,000 caribou, which we suspected might include 75% or more males, did not appreciably lower the October 1983 bull:cow ratio (Table 2) as we suspected it should. These observations will be elaborated on as additional data are obtained.

Analysis of Past Data

The role of disturbance on the DCH was reviewed. Two papers about disturbance (Disturbance and the Delta Caribou Herd; The Reaction of Caribou to Aircraft: A comparison of two herds) were presented at the 1st North American Caribou Workshop in Whitehorse, Yukon (28-29 Sep 1983) and appear as Appendices C and D.

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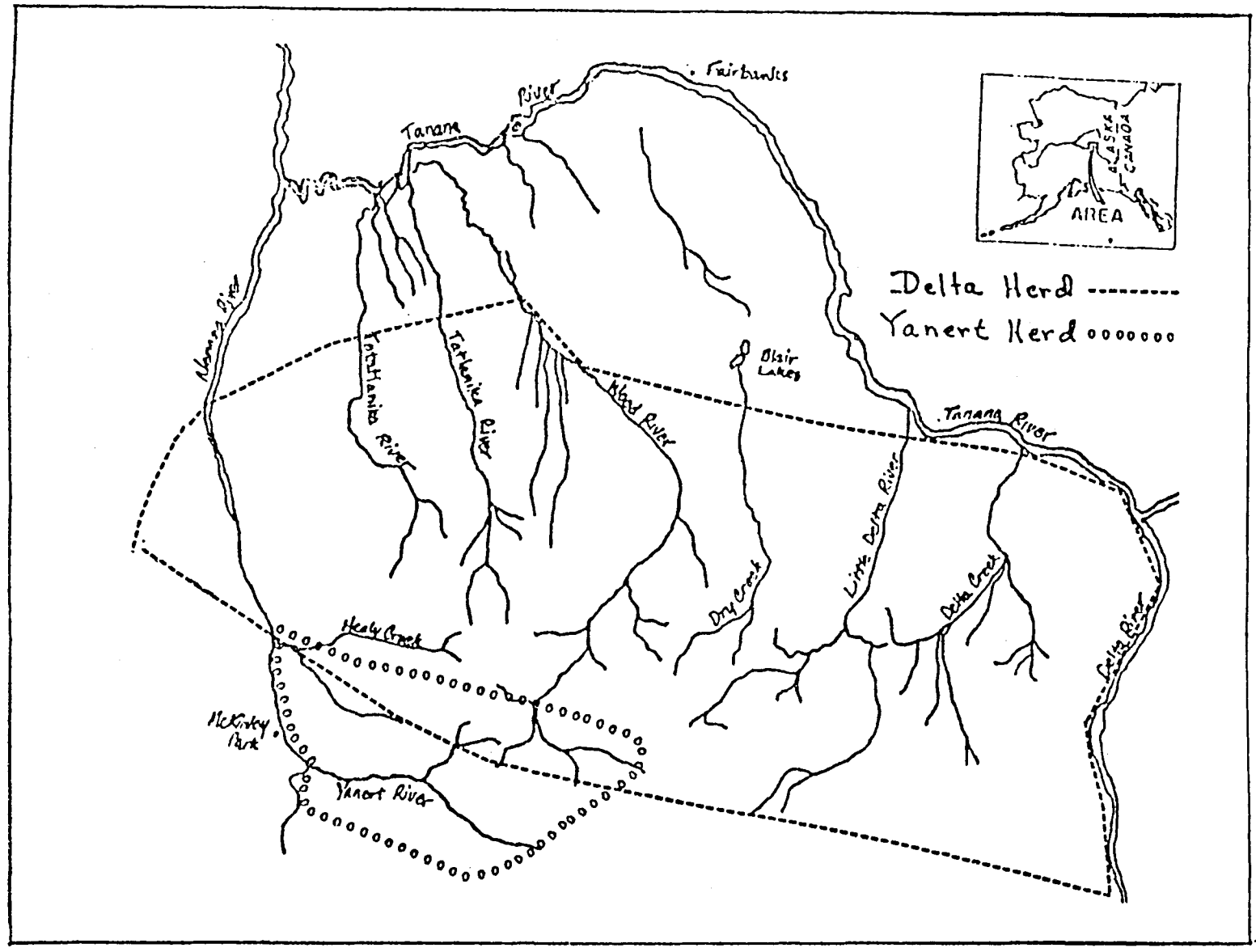

Fig. 1. Ranges of the Delta and Yanert Caribou Herds, 1982-83.

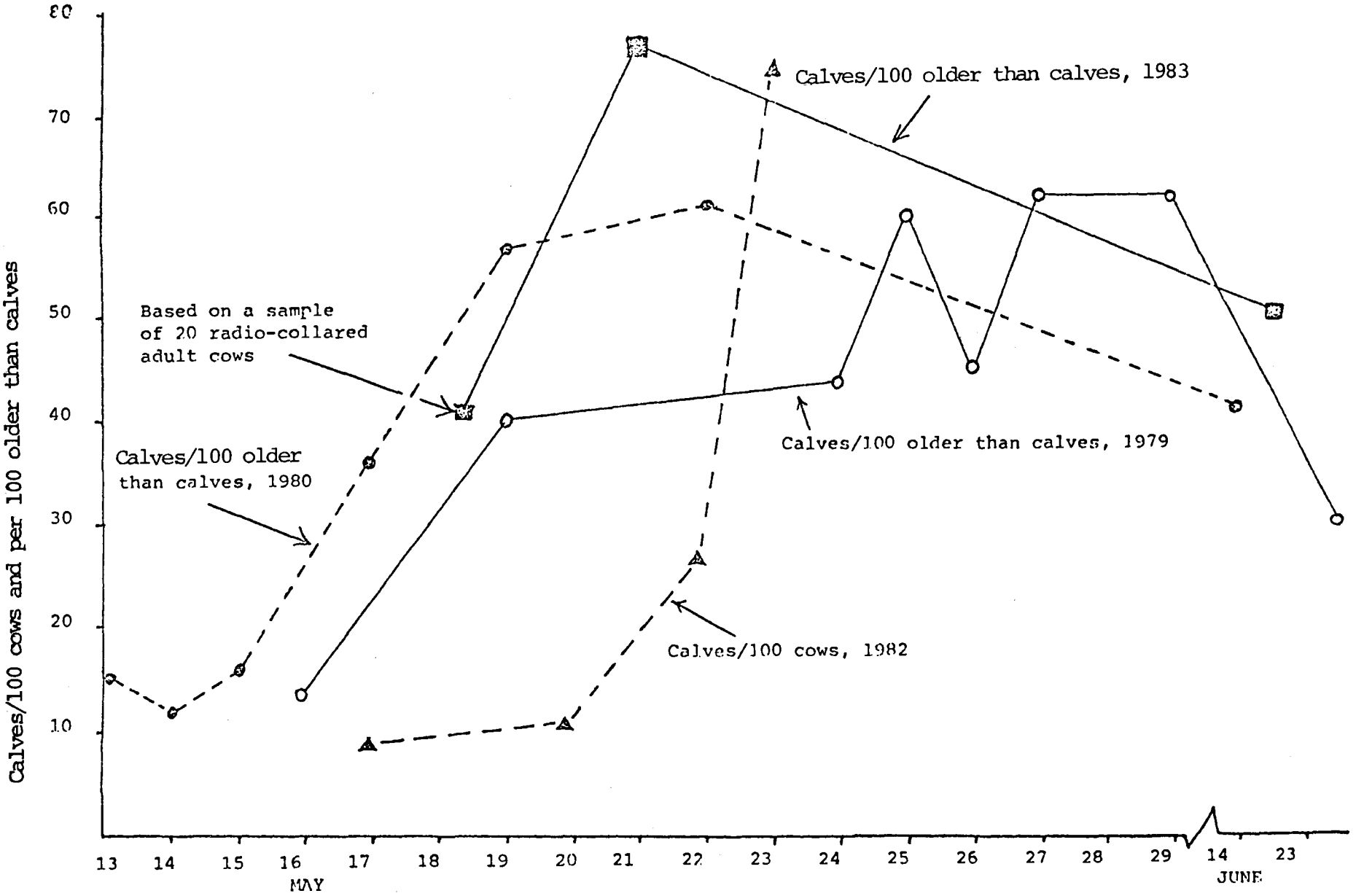

Fig. 2. Calving chronology in the Delta Caribou Herd, 1979, 1980, 1982, and 1983.

KEY:

Area	Calves/100 caribou older than calves	Sample Size
A =	83	1,442
B =	65	409
C =	24	62
D =	25	25
E =	10	65

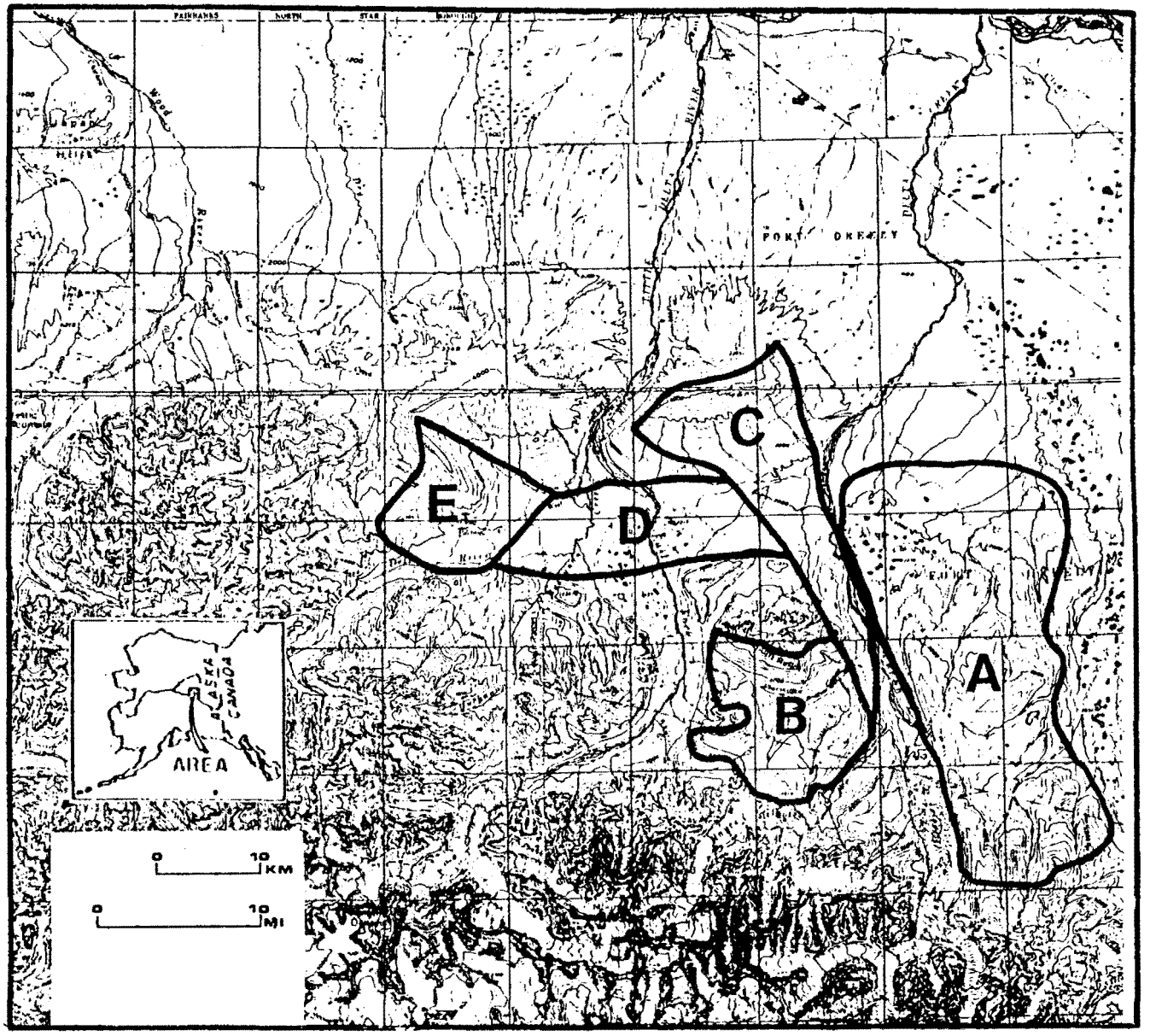

Fig. 3. Calving distribution and calf production by area in the Delta Caribou Herd, 21 May 1983.

Table 1. Dates of flights from which radio-collared Delta Herd caribou were relocated, 19 November 1982-15 October 1983.

Date	Aircraft	Remarks
19 Nov 1982	Scout	
20 Jan 1983	Scout	
14 Feb 1983	Super Cub	
29 Mar 1983	Scout	
1 Apr 1983	Bell 206B helicopter	Tagging
12 Apr 1983	Super Cub	
20 Apr 1983	Bell 206B helicopter	Spring composition survey
18 May 1983	Super Cub	
19 May 1983	Super Cub	
21 May 1983	2 Super Cubs	
27 May 1983	Super Cub	
28 May 1983	Super Cub	
29 May 1983	Super Cub	
12 Jun 1983	Scout	
14 Jun 1983	Beaver, Scout, 2 Super Cubs	
15 Jun 1983	Scout, 2 Super Cubs, Bell 206B helicopter	
5 Aug 1983	Scout	
4 Oct 1983	Scout, Bell 206B helicopter	

Table 2. Sex and age composition of Alaska's Delta Caribou Herd, 1969-83.

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	11.0	85	15	116	53	410	21	166	777
10/21-23/70	77	23	34	9.3	88	14	129	42	383	33	296	896
10/29-11/1/71	29	11	16	6.8	78	9	109	64	738	18	214	1,139
10/27-31/72	32	6	10	3.9	46	7	85	67	795	21	259	1,185
10/23-24/73	28	4	10	2.8	29	7	76	70	735	20	210	1,050
10/23-25/74	27	2	2	1.4	16	1	17	76	868	21	240	1,141
6/11-12/75	3	<1	12	0.3	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	0.5	5	24	258	54	572	20	220	1,055
6/16-19/77	9	12	34	7.8	95	22	269	64	784	6	76	1,224
10/26-11/2/77	32	6	42	3.2	44	23	319	55	756	18	246	1,365
6/13-14/78	12	8	23	5.5	52	16	157	69	661	8	81	951
10/26/78	75	10	39	4.5	33	17	126	44	324	33	242	725
6/23/79	11	18	44	10.3	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	9.0	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	--	--	33	522	64	1,021	3	44	1,587
10/4/83	54	--	46	--	--	23	307	50	665	39	139	1,333

[a] Yanert Herd.

Table 3. Permanent accession numbers and other pertinent information for radio-collared Delta and Yanert Herd caribou, 1979-83.

Accession No.[a]	Collar No.[b]	Year of birth	Sex	Date collared (recollared)	Herd	Comments
101,972	YR-57 BKY-36	1978	F	1/4/79 (2/11/82)	Delta	
101,973	YR-53 BKY-28	1978	F	1/4/79 (2/11/82)	Delta	
101,974	YR-88 BKY-37	1978	F	1/8/79 (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 BKY-49	1978	F	1/9/79 (2/26/82)	Delta	
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 BKY-20	1978	F	1/10/79 (5/30/81)	Delta	Died from recapture
101,982	YR-52 BKY-78	1978	F	1/10/79 (2/11/82)	Delta	
101,983	BKY-59	1978	M	1/10/79	Delta	Killed by grizzly 8/80
101,984	YR-54 BKY-47	1978	F	1/11/79 (2/26/82)	Delta	
101,985	YR-58 BKY-79	1978	M	3/30/79 (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 5/79
101,988	YR-56 BKY-25	1978	F	1/4/79 (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 BKY-26	1978	F	3/30/79 (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

Table 3. Continued.

Accession No.[a]	Collar No.[b]	Year of birth	Sex	Date collared (recollared)	Herd	Comments
101,997	YR-77 BKY-20	1978	F	3/30/79 (2/26/82)	Delta	Alive, but collar on mortality pulse
102,341	BKY-15	1980	F	2/8/81	Delta	
102,342	BKY-86	1979(?)	M	2/8/81	Delta	Killed 2/81 (wolves?)
102,343	BKY-13	1980	F	2/8/81	Delta	
102,348	BKY-14	1980	F	2/27/81	Delta	
102,349	BKY-12	1979(?)	F	2/27/81	Delta	
102,350	BKY-22	1978(?)	F	2/27/81	Delta	
102,360	BKY-16	1980	F	3/22/81	Delta	
102,361	BKY-21	1980	M	3/22/81	Delta	
102,362	BKY-18	pre-1978	F	3/22/81	Delta	
102,363	BKY-29	pre-1979	F	4/18/81	Yanert	
102,364	BKY-30	pre-1980	F	4/18/81	Yanert	
102,365	BKY-31	pre-1979	F	4/18/81	Yanert	
102,366	BKY-32	pre-1979	F	4/18/81	Yanert	Missing since 4/18/81
102,367	BKY-33	pre-1980	F	4/18/81	Yanert	
102,368	BKY-34	pre-1979	F	4/18/81	Yanert	
102,369	BKY-35	pre-1979	F	4/18/81	Yanert	
102,370	BKY-70	pre-1979	F	4/18/81	Yanert	
102,430	BKY-19	1980	F	5/30/81	Delta	
102,431	BKY-23	1980	F	5/30/81	Delta	
102,432	BKY-27	1980	F	5/30/81	Delta	
102,546	BKY-9	1981	F	5/3/82	Delta	
102,547	BKY-10	1981	F	5/3/82	Delta	Eaten by grizzly
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	
102,808	BKY-48	1982	F	4/1/83	Delta	
102,809	BKY-10	1982	F	4/1/83	Delta	

Table 3. Continued.

Accession No.[a]	Collar No.[b]	Year of birth	Sex	Date collared (recollared)	Herd	Comments
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	

Note: Underlined collar numbers are those that were functioning during the period covered by this report.

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

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

Table 4. Induction time for 10-month-old female caribou from the Delta Herd immobilized with 4.5 mg etorphine hydrochloride combined with 5.0 mg acepromazine maleate, 1 April 1983.

Accession No.	Collar No.[a]	Induction time (min)	Recovery time after 10 mg diprenorphine hydrochloride[b]	Weight kg	Weight lb	Comments
102,803	BKY-40	6	3.5	65.8	145	Quivering contractions
102,804	BKY-43	5	4-5	63.5	140	
102,805	BKY-41	6(?)	?	65.3	144	Heavily sedated
102,806	BKY-42	6	7.5	68.0	150	
102,807	BKY-39	5	6.5	59.0	130	
102,808	BKY-48	5.5	4.5	70.8	156	
102,809	BKY-10	6	5	67.6	149	
102,810	BKY-45	3	4.5	57.6	127	
102,811	BKY-44	3	5-6	60.8	134	1st dart bounced out, down 3 min after 2nd dart
102,812	BKY-17	7	5	56.7	125	
102,813	None	17	6	81.6	180	Greatly increased induction times possibly related to reduced ambient temperature
102,814	BKY-46	>15	3.5	59.0	130	
102,815	BKY-3	18	3.5	73.5	162	

[a] All collars are yellow with black numbers.
[b] All caribou given diprenorphine hydrochloride intramuscularly except BKY-44 given intravenously.

Table 5. Means and standard deviations of body measurements (cm) and weights of radio-collared 10- to 11-month-old female caribou, Delta Herd, 1979, 1981, 1982, and 1983.

Year	Shoulder height	Total length	Chest girth	Metatarsal length	Hind foot length	Face length	Neck circumference	Body weight kg	Body weight lb
1979	102.5±5.3 N = 11	168.5±6.5 N = 12	103.3±4.3 N = 12	37.8±1.3 N = 12	53.3±2.3 N = 12	32.7±2.3 N = 10	42.2±2.0 N = 11	61.4±3.7 N = 11	135.3±8.1 N = 11
1981	100.5±3.9 N = 4	174.5±6.6 N = 6	105.0±7.1 N = 6	39.5±1.0 N = 4	54.7±3.3 N = 6	35.8±1.5 N = 5	41.3±2.4 N = 6	61.8±7.5 N = 4	136.3±16.5 N = 4
1982	--	165.0±7.0 N = 7	96.9±4.4 N = 9	38.1±1.1 N = 10	52.7±1.9 N = 11	32.7±2.5 N = 11	39.7±2.6 N = 11	62.5±5.6 N = 11	137.8±12.5 N = 11
1983	--	168.3±6.8 N = 12	97.0±5.0 N = 11	38.0±1.3 N = 12	52.1±1.9 N = 12	33.9±4.1 N = 11	40.4±1.5 N = 9	64.0±5.4 N = 12	141.0±12.0 N = 12

Table 6. Stages of eruption of incisiform teeth of 10-month-old female Delta caribou, 1983.

Accession No.	i1		i2		i3		c1		Weight	
	R	L	R	L	R	L	R	L	kg	lb
102,803	D	D	D	D	D	D	D	D	65.8	145
102,804	--		--		--		--		63.5	140
102,805	D	D	D	D	D	D	D	D	65.3	144
102,806	P	P	D	A	D	D	D	D	68.0	150
102,807	D	D	D	D	D	D	D	D	59.0	130
102,808	A	A	D	D	D	D	D	D	70.8	156
102,809	D	D	D	D	D	D	D	D	67.6	149
102,810	E	A	D	D	D	D	D	D	57.6	127
102,811	E	E	D	D	D	D	D	D	60.8	134
102,812	D	D	D	D	D	D	D	D	56.7	125
102,814	D	E	D	D	D	D	D	D	59.0	130
102,815	P	P	E	E	D	D	D	E	73.5	162

D = Milk tooth.

E = Erupting tooth. An erupting tooth has a stained portion but has not migrated to its position of permanent orientation.

A = Absent tooth (permanent tooth not yet erupted).

P = Permanent tooth.

Table 7. Reproductive history of radio-collared female caribou from the Delta and Yanert Herds, 1979-83.

Accession No.	Collar No.[a]	Year collared	Year of birth	Produced a calf 1979	1980	1981	1982	1983	Comments
101,972	BKY-36	1979	1978	No	Yes	Yes	Yes	Yes	
101,973	BKY-28	1979	1978	No	No	Yes	No	Yes	
101,974	BKY-37	1979	1978	No	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	
101,984	BKY-47	1979	1978	No	Yes	Yes	No	Yes	
101,988	BKY-25	1979	1978	No	No	No	Yes	Yes	
101,993	BKY-26	1979	1978	No	Unk	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	
102,341	BKY-15	1981	1980	--	--	No	No	Yes	
102,343	BKY-13	1981	1980	--	--	Unk	No	Yes	
102,348	BKY-14	1981	1980	--	--	No	No	Yes	
102,349	BKY-12	1981	1979?	--	--	Yes	Unk	Yes	
102,350	BKY-22	1981	1978?	--	--	Yes	Yes	Yes	
102,360	BKY-16	1981	1980	--	--	No	No	Yes	
102,362	BKY-18	1981	pre-1978	--	--	Yes	Yes	Yes	
102,363	BKY-29	1981	pre-1979	--	--	Yes	No	No	Yanert Herd
102,364	BKY-30	1981	pre-1980	--	--	No	Yes	Yes	Yanert Herd
102,365	BKY-31	1981	pre-1979	--	--	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	Yanert Herd
102,368	BKY-34	1981	pre-1979	--	--	Yes	Yes	Yes	Yanert Herd
102,369	BKY-35	1981	pre-1979	--	--	Yes	Yes	Yes	Yanert Herd
102,370	BKY-70	1981	pre-1979	--	--	Yes	Yes	No	Yanert Herd
102,430	BKY-19	1981	1980	--	--	No	No	Yes	
102,431	BKY-23	1981	1980	--	--	No	No	Yes	
102,432	BKY-27	1981	1980	--	--	No	No	Yes	
102,546	BKY-9	1982	1981	--	--	--	No	No	
102,547	BKY-10	1982	1981	--	--	--	--	--	Died
102,548	BKY-7	1982	1981	--	--	--	No	No	
102,549	BKY-6	1982	1981	--	--	--	No	No	
102,560	BKY-1	1982	1981	--	--	--	No	No	
102,561	BKY-4	1982	1981	--	--	--	No	No	
102,562	BKY-2	1982	1981	--	--	--	No	Yes	
102,563	BKY-5	1982	1981	--	--	--	No	No	
102,564	BKY-3	1982	1981	--	--	--	No	--	Died
102,561	BKY-4	1982	1981	--	--	--	No	No	
102,562	BKY-2	1982	1981	--	--	--	No	Yes	
102,563	BKY-5	1982	1981	--	--	--	No	No	
102,564	BKY-3	1982	1981	--	--	--	No	--	Died
102,565	BKY-0	1982	1981	--	--	--	No	No	
102,566	BKY-8	1982	1981	--	--	--	No	No	

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

Table 8. Age-related natality rate of radio-collared female caribou from the Delta and Yanert Herds, 1980-83.

Year	Natality of females by age			
	24 months (%)	36 months (%)	48 months and older (%)	All females (%)
1980	6/9 (67)	--	--	6/9 (67)
1981	1/1 (100)	9/12 (75)	1/1 (100)	17/21 (81)
1982	0/7 (0)	--	7/10 (70)	13/25 (52)
1983	1/9 (11)	7/7 (100)	10/15 (66)	16/34 (47)
Means	8/26 (31)	16/21 (76)	18/26 (69)	52/89 (58)

Table 9. Harvest of Delta caribou, 1968-83.[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	

[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 12/3/70.

Table 10. Hunting seasons and bag limits for Delta caribou, 1968-83.[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 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-Dec 31 by registration permit. A total of 400 caribou may be taken.
1982-83	10 Aug-30 Sep 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.
1983-84[d]	10 Aug-31 Mar	One caribou

[a] Subunit 20A and part of 20C.
[b] Amended by emergency announcement to close 20 Sep.
[c] Amended by emergency announcement to No Open Season.
[d] Amended by emergency announcement to close 28 Oct.