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Division of Wildlife Conservation
Research Progress Report

POPULATION DYNAMICS OF THE MENTASTA CARIBOU HERD

by
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PROGRESS REPORT

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SUMMARY

In order to evaluate the population dynamics and status of the Mentasta Caribou (Rangifer tarandus) Herd (MCH), productivity, cow and calf mortality, seasonal range use, and herd interchange were studied. Condition parameters evaluated during late winter suggest that the MCH was normal, relative to the adjacent healthy Nelchina Caribou Herd (NCH). Based on calving and antler retention of radio-collared cows and a distended-udder survey of the entire herd, the proportions of radio-collared cows that had given birth to calves were estimated at 63-78% and 72%, respectively. These estimates are similar to pregnancy rates determined for the NCH.

Survival of calves to the end of the calving period was low. The calf:cow ratio among radio-collared cows was 22:100; a postcalving composition survey of the herd resulted in a calf:cow ratio of 18:100. These ratios are substantially lower than those in previous years (i.e., averaging 42:100 from 1981 to 1985). Calves born during the 1st week of the calving period had a high (87%) survival rate. In contrast, none of the calves born during the remaining 3 weeks of the calving period survived to the end of the calving period. Limited information suggests that this neonatal mortality was a result of predation. Calf mortality during the rest of the year (67%) was higher than that observed in the adjacent NCH (38%). Mortality among radio-collared adult cows was also higher (17%) than that of the adjacent NCH (10%). Most of the adult mortality in the MCH occurred before and during the calving period. Survival of adult cows through fall and winter was good. For the first time in 5 years, the MCH declined substantially in 1987-88 (i.e., from approximately

2,800 in 1986-87 to about 2,400 caribou). Range use by radio-collared cows during the calving period suggests that 5 discreet calving areas were used. The highest rate of calving mortality was observed in the principle calving area, while substantially lower mortality rates were observed at 4 peripheral sites.

Key words: calving, caribou, Mentasta, mortality, population dynamics, productivity, Rangifer

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BACKGROUND

The Mentasta Caribou Herd's range (Fig. 1) is primarily in Game Management Unit (GMU) 11 (i.e., from the Mentasta Mountains southwest along the north and west slopes of the Wrangell Mountains to approximately the Chetaslina River). Recent telemetry work has demonstrated that Mentasta caribou also winter in the Tetlin, Nabesna, and lower Chisana drainages of GMU 12. The herd is usually found within Wrangell Saint Elias National Park and Preserve.

Annual censuses of this herd from 1971 to 1986 have resulted in population estimates ranging from approximately 2,200 to 3,200 caribou (Bos 1974; Lieb 1984, 1986a). No trend has been detected during this period.

Composition data suggest that herd productivity, while lower than that observed in the adjacent NCH, should be adequate for herd growth. Summer postcalving composition surveys over the past 10 years have found calf:cow ratios ranging from 30 to

50 calves:100 cows. Very limited composition data is available concerning survival to 11 months in the MCH.

Factors that may be limiting the growth of this herd include range condition, predation, poaching, legal hunter harvest, severe winter conditions, and emigration. The influence of range condition on the well being of the MCH is not known. Observations at a number of sites over the past few years suggest that lichen production may be low throughout a large portion of the herd's range. Information concerning the range relationships of some other caribou herds is available (Boertje 1984, Klein 1982, Lieb 1986b, Skoog 1968, Skuncke 1969, Thompson & McCourt 1981, White & Trudell 1980).

An Alaska Department of Fish and Game (ADF&G) and National Park Service (NPS) cooperative MCH range study was initiated in 1982 (Martin 1983). Six exclosures were initially constructed at sites used during various seasons of the year. The study plan called for these exclosures to be examined every 5 years over a 35-year period, to both monitor the successional development of undisturbed exclosure vegetation and compare it to adjacent vegetation exposed to the grazing and trampling effects of caribou. To date there has been no reexamination of the exclosures. There is some question as to whether the 6 exclosures can adequately provide a reasonable overview of range condition and use. If the decision is ever made to evaluate the Mentasta caribou range, a series of vegetation transects and additional exclosures may be needed.

Skoog (1968) raised concern that frequent use by Nelchina caribou of a substantial portion of the winter range utilized by Mentasta caribou may be adversely affecting that range (Fig. 2). Bergerud (1980) suggested that there is little need for concern, believing that dispersal restrictions and forage carrying capacity do not begin to seriously limit caribou population growth until densities approaching 10 caribou/mi^2 are reached. However, a more recent study on the George River Herd suggested that herd growth and vigor begin to decline at densities approaching 5 caribou/mi^2 (Courturier 1987). Range inadequacies may be expressed through decline in physical condition, reduced calf production, increased calf mortality at various times of the year, increased adult mortality, and/or loss of caribou from emigration.

Little is known about the influence of predation on MCH or the size of predator populations on and adjacent to its range. Information from hunters and trappers, as well as observations made by ADF&G personnel, suggest that both wolf (Canis lupus) and grizzly bear (Ursus arctos) numbers are relatively high over the Mentasta caribou range. The ADF&G grizzly bear

sealing records indicate that the bear population in GMU 11 is relatively old-aged and unexploited.

Studies of other caribou herds suggest that predation by bears and wolves can be significant. Skoog (1968) reported that grizzly bear numbers were high on the Nelchina caribou calving grounds during calving. He suggested that predation on caribou by bears was probably highest on newborn calves and the importance of such predation could be substantial if bears moved onto calving grounds, creating high bear densities. Wolf predation has been reported to be substantial both on newborn caribou calves and on calves and adults throughout the year in the Denali and Nelchina Caribou Herds (Murie 1944, Van Ballenberghe 1985). Miller et al. (1987) reported that wolves engaged in surplus and excessive killing of calves on calving grounds of the Beverly Caribou Herd in the Northwest Territories; substantial numbers of wolf-killed calf carcasses on which there had been either no feeding or feeding only on milk curds and viscera were found. Most of these dead calves had been subsequently scavenged by birds and, to a lesser extent, by foxes and bears.

Some poaching of Mentasta caribou has occurred over the past few years, primarily during the winter period when they were near the Slana-Nabesna Road or Tetlin-Northway areas. Whether animals are taken in enough numbers to substantially impact the herd is not known.

Sport and subsistence hunting of the MCH are regulated by drawing and registration permits, respectively. From 1983 to 1987, an average of 188 sport and subsistence hunters have reported hunting this herd each year. Recent harvests of 75-150 animals represent a 3-5% combined sport and subsistence hunting mortality rate for the total herd (Lieb 1986a).

Severe winter conditions might contribute towards increased late-winter mortality. However, weather records (>20-year period) suggest that winter severity, expressed as a function of monthly snow depth and mean temperatures, has been mild to average over the past 5 years (i.e., 1983-1987). In addition, over the same 5-year period a substantial portion of the vigorously growing NCH has wintered on much of the area utilized by the MCH.

We were concerned that herd fidelity by Mentasta caribou and the possibility that some emigration from the Mentasta range may occur because relatively large numbers of Nelchina caribou regularly winter on portions of the winter range used by Mentasta caribou. Such emigration might be expected to involve juveniles (i.e., short yearlings and, possibly, short 2-year-old caribou) during the late winter and early spring

when mother-offspring bonds are broken or weakened as the calving period approaches (Skoog 1968).

In summary, one or a combination of the following factors may be limiting the growth of the MCH: (1) inadequate forage during one or more seasons of the year, (2) predation of newborn calves, (3) predation of adult and juvenile caribou during various seasons of the year, (4) legal hunting, (5) illegal harvest by humans, and (6) emigration.

GOAL

To develop a comprehensive understanding of MCH population dynamics for future management of this herd and other herds in Alaska.

OBJECTIVES

1. To evaluate the productivity of adult and yearling females.
2. To evaluate the magnitude and timing of mortality of calves, yearling females, and adult females.
3. To estimate the population size, composition, and growth rate of the MCH.
4. To determine the seasonal distribution and movements of adult and yearling female segments of the MCH.
5. To evaluate range overlapping and MCH herd member interchanging with the adjacent NCH and Chisana Caribou Herd (CCH).
6. To evaluate the growth and condition of Mentasta caribou, relative to other caribou herds in North America.

PROCEDURES

Capture and Marking (Job 1)

Thirty-nine caribou, including 28 adult females, 9 yearling females, 1 bull, and 1 calf, were captured using helicopter darting methods during the spring of 1987 (Appendix A). The 37 females were radio-collared at that time; two of them died within 24 hours of their capture. To meet Objective No. 6, a blood sample and 1 tooth were collected from each animal at the time of capture; body measurements were also taken.

Blood was drawn by utilizing standard venipuncture techniques with sterile vacutainer needles and stored in (1) sterile tubes for serology and (2) tubes containing EDTA for hematology. Packed cell volume (PCV) and total protein (TP) values were obtained from all samples within 48 hours of collection. Blood serum was separated and frozen for additional analyses, including disease profiles and serum chemistry, to aid in evaluation of herd condition. Each animal's condition was ranked at the time of capture, based on subcutaneous fat and muscle tissue along the ribs and spine, condition of the pelage, and the presence of any detectable injuries or disease processes.

Census and Composition Counts (Job 2)

To meet Objectives Nos. 2 and 3, an aerial (fixed-wing) census of the herd was completed during the postcalving aggregation period (i.e., late June). Using a helicopter, a sex and age composition survey was also completed at that time. Fall and spring aerial (helicopter) surveys were conducted to monitor the sex and age composition of the herd and evaluate calf survival.

Parturition Survey (Job 3)

To meet Objectives Nos. 1 and 2, a helicopter survey was conducted a few days after the peak of calving to determine the proportion of cows with distended udders. Based on a combination of the resulting survey data and information on the distribution of calving dates for radio-collared cows, the parturition rate was estimated.

Intensive Calving Surveys (Job 4)

To meet Objectives Nos. 1 and 2, radio-tracking surveys were conducted on a daily basis from mid-May (i.e., onset of calving) to approximately mid-June to monitor calving and early calf mortality associated with radio-collared adult and yearling females. Radio collars used in this study had a mortality, or inactive pulse rate, mode. When possible, dead radio-collared caribou were examined in an attempt to determine the cause of death.

Periodic Relocations (Job 5)

To meet Objectives Nos. 2, 4, and 5, the 37 caribou radio-collared in April 1987 and 8 other radio-collared cows were aerially located throughout the year at monthly intervals. Some of these radio-collared cows had left the Mentasta range; others had died during the year. Locations were plotted on topographic maps, and associated information (i.e.,

date, time, habitat type, group size, and composition) was recorded on standardized forms.

Nelchina Caribou Relocations (Job 6)

To meet Objective No. 5, 45 radio-collared caribou in the NCH were occasionally monitored. During the winter period when Nelchina caribou had moved onto portions of the winter range normally utilized by the MCH, they were radio-located whenever monitoring activities were conducted in the MCH. Radio locations of caribou additionally facilitated in locating components of the herd and determining the proper timing of the annual herd count, composition surveys, udder survey, and intensive monitoring of neonatal activity.

RESULTS AND DISCUSSION

Body Measurements

Various body measurements were taken from 37 of the caribou captured for radio-collaring in April 1987. Table 1 summarizes morphometric data for 4 age groups. With the exception of hind-foot length, all body measurements from the calf to the 3+ year age classes increased. Hind-foot length increased only through the 2-year age class. Total lengths and hind-foot lengths for the individual age classes were all equal to or larger than corresponding measurements (Skoog 1968) taken from 4 caribou herds (i.e., Alaska Peninsula, Western Arctic, Forty Mile, and Nelchina). Skoog provided no measurement data from other herds that were comparable to the body measurements examined in this study.

Eight of the caribou radio-collared in April 1987 left the Mentasta range shortly after collaring and are assumed to be Nelchina caribou. Seven of these 8 animals were measured; the results were compared with the remaining 28 sets of Mentasta caribou measurements. Averages for this small subset of measurements were about the same as for those of the Mentasta caribou.

Body Condition

The overall physical condition of captured Mentasta caribou was assessed, and this information will be compared with similar information obtained from other herds. Franzmann and LeResche (1978) discussed certain hematological and blood chemistry values used to detect differences in body condition that may be related to nutrition. Results obtained from examining these parameters, however, have been to some degree inconclusive because animals, even when nutritionally

stressed, tend to maintain the homeostasis of their blood, thus masking deficiencies (Franzmann 1983). Franzmann suggested that these tests may function best in identifying condition extremes, either very healthy or very stressed. Messier et al. (1987) reported difficulties in using blood parameters to assess nutritional status of caribou and felt that body fat was a more reliable indicator of condition. However, a reasonable technique for obtaining suitable body fat measurements from live animals under field conditions has yet to be developed.

Packed cell volume and TP values were selected because they may be relative indicators of condition and are not influenced as much as other parameters by the capture process (Franzmann and Schwartz 1983). These values, which were obtained from all captured caribou, are presented in Appendix B. Initial evaluation of these results suggest the animals tested were not nutritionally stressed, because the values fell within ranges considered to be normal for wild ungulates (Tobey, pers. commun.).

Appendix B lists the field condition ranking for all captured caribou. Most animals were in fair-to-good condition at a time of year when caribou are generally considered to be in the poorest condition (Skoog 1968). This suggests that Mentasta caribou are not nutritionally stressed.

Future studies will include the comparison of this year's condition parameters with those of animals captured in subsequent years to see if yearly variations occur. In addition, we will attempt to compare Mentasta caribou values with those from other herds in Alaska.

Natality for Radio-collared Cows

Two of the 35 radio-collared cows that remained on the Mentasta range in the spring of 1987 died prior to the beginning of the calving period. During the calving period (i.e., 19 May to 16 June), the remaining 33 radio-collared Mentasta cows were intensively monitored (Table 2). Radiolocation flights were made on 21 out of 29 days; 417 individual observations were made. Each caribou was observed from 8 to 17 times ($\bar{x}$ = 12.6); most cows were observed approximately every other day. Table 3 summarizes the calving status of the 33 radio-collared cows. Intensive monitoring of a cow was discontinued if she lost her calf. Two cows died during the calving period.

There were 22 cows observed with calves, representing 67% of the radio-collared cows. The age structure of this sample did not closely represent the estimated age structure of the herd;

therefore, utilizing the 3 age classes recognized by Skoog (1968) as having different pregnancy rates (i.e., 1-year-olds, 2-year-olds, and adult), a weighted minimal pregnancy rate of 63% was derived. When an additional 6 cows who had retained their antlers into mid-May and early June (i.e., an indication of pregnancy) but had not been observed with calves (see following section) were added to those cows observed with calves, the weighted pregnancy rate was 78%.

The first new calf was observed on 20 May; the last new one on 10 June. The median calving date for the radio-collared cows was 28 May. Over an 8-year period Skoog (1968) observed calving in the NCH to occur from 14 May to 12 June; approximately 50% of the calving had been completed by 25 May.

Antler Drop

As part of the program to intensively monitor calving activity during the calving season, radio-collared cows were monitored for the presence or absence of antlers and for any new antler growth on those cows that had shed their antlers. According to Skoog (1968), only a small percentage (5%) of antlerless cows at the beginning of the calving period were pregnant. He also felt that practically all cows with antlers at the beginning of the calving period were pregnant. He concluded that the proportion of antlered cows just prior to the calving period was a reliable estimate of pregnancy.

Skoog found that once the calving period had begun, all but approximately 3% of antlered calving cows retained antlers for at least 2 days after calving. Various authors have indicated that pregnant caribou and/or reindeer retain antlers for 3-7 days after parturition (Palmer 1934, Flesov 1952, Lent 1965); our findings in 1987 were substantially different from these. The earliest antler drop among nonpregnant Nelchina cows observed by Skoog (1968) was approximately 15 April. During this study two 3+ year-old radio-collared cows that had not been observed with calves were judged to have dropped antlers a few days prior to being observed on 7 April, based on blood-stained antler pedicels. Of the cows that had been observed with calves in 1987, the earliest incident of antler shedding occurred on 17 May. Antler-shedding dates were estimated for 20 of 22 calving cows: 25% (n = 5) occurred 7-18 days prior to calving, 15% (n = 3) 1-6 days prior to calving, 55% (n = 11) 1-6 days after calving, and 5% (n = 1) 7-10 days after calving. Table 4 summarizes the timing of antler drop relative to calving.

Of the 11 "noncalving" cows, the six that shed their antlers after 15 May (between mid-May and mid-June) should be considered as possibly having calved. The earliest of these

6 cows shed her antlers on 15 May, 8 days after that of a radio-collared cow. Any of those who calved lost antlers within approximately the first 48 hours after parturition. If, as we suspect, Skoog (1968) was correct about cows with antlers present at the beginning of the calving season, then 85% (28/33), or a weighted rate of 78%, of the radio-collared cows were pregnant, including a 50% (2/4) pregnancy for the yearlings.

Calving Rate from Distended Udder Survey

A helicopter survey of the MCH on their calving grounds was conducted on 30 May. The survey was timed so that it would occur close to or after the peak of calving but prior to the formation of relatively large (20 to 25+ animals) postcalving aggregations. Approximately 450 cows older than 1 year of age were evaluated; 65% of these cows (i.e., either with or without calves) had distended udders (Table 5). Based on Bergerud's (1964) work, a caribou udder becomes distended sufficiently to be recognized 5 days prior to calving and shrinks to where it is no longer obviously distended approximately 17 days after nursing ceases. This means the udder survey conducted on 30 May evaluated parturition from 13 May to 4 June. If we assume that no calving occurred prior to 13 May, based on 91% of the radio-collared cows calving during this period (i.e., 13 May-4 June), a parturition rate of 72% was extrapolated for the entire calving period. This rate is the same as the 72% pregnancy rate Skoog (1968) determined for the Nelchina Herd females >1 year of age and falls between the low (63%) and high (78%) pregnancy rate estimates for the radio-collared cows.

Calf Mortality

Appendix C lists all radio-collared cows that were observed with a calf, including the estimated date some calves were lost (Fig. 3). The number of days a calf survived is a maximum estimate and, in part, is a function of the monitoring frequency of the radio-collared cows. If the monitoring frequency had been increased from approximately once per 2 days to once per day, the length of survival would have probably decreased. Table 6 summarizes the calving data to show the changes in calf composition as related to births and deaths.

Table 7 shows the weekly distribution of calving and calf mortality during the calving period. Calves born during the 1st week of the calving period had a high probability of surviving until the end of the calving period: 87% of such calves were still alive on 16 June (i.e., the end of the calving period). Of the calves born during the remaining

3 weeks of the calving period, all died before the end of it. Sixty-seven percent of the calf mortality during the calving period occurred within 4 days following birth. The mean length of survival for these animals was 4.5 days. Because radiolocations were attempted every other day, these survival times are maximum estimates; they could actually be substantially shorter in duration.

Of 22 cows observed with calves, 15 (68%) lost them during the calving period (prior to 16 June). Of the remaining 7 calves, 3 were lost during the subsequent summer period and one disappeared during the 1987-88 winter period. Since it is unlikely that calf-cow bonds were broken before mid-March, it is reasonable to assume this calf died. In addition, 1 radio-collared cow with a calf died during the winter; since we had no information concerning the calf's status, the total calf pool was reduced to six.

Based on our observation of 6 radio-collared cows with calves, the overall survival to 1 year of age of those calves surviving to the end of the calving period appears to have been lower than what has been observed in the NCH. As previously indicated, 67% (4/6) of the Mentasta calves surviving to the end of the calving period died before the following spring. Based on an estimated average annual calf survival rate (i.e., birth to 1 year of age) of 44% for the NCH from 1980 to 1983 (Pitcher 1987) and assuming the same birth rate as that for the MCH in 1987 (72%), approximately 46% ((59-(72*.44))/59) of Nelchina calves surviving to the end of the calving period died before the following spring.

Causes of Calf Mortality

Because calves were not radio-collared, only limited information concerning cause of mortality could be obtained from observations made during fixed-wing radio-tracking surveys. Helicopter support was typically not available for getting to the calving grounds quickly. Of 15 calves that died, 11 (73%) disappeared, and no information was obtained concerning the causes of death. Of the remaining 4 calves, one was associated with fresh wolf sign, a grizzly bear was feeding on another, and two were observed dead near their mothers. Golden eagles (Aquila chrysaetos) were circling over one of these latter two.

Additional observations of wolves, grizzly bears, and golden eagles or the fresh sign of these animals during radio-tracking surveys of the calving grounds may causally relate to the calf mortality. Prior to 29 May one observation of a wolf was made; whereas, 3 wolf sightings, 3 grizzly bear sightings,

and 5 eagle sightings were recorded during the 2nd half of the calving period when most of the calf mortality occurred.

Weather

Inclement weather during the calving period, especially when close to the peak of calving, can have a substantially negative effect on neonatal calf survival. A number of authors have reported lowered calf survival coinciding with uncharacteristically heavy snow and rain in the spring (Skoog 1968, Bergerud 1983). Temperatures recorded at Gulkana airport, approximately 30 air miles west of the principal calving area, ranged from 29 F to 79 F, averaging 49 F during the calving period and reflecting normal temperature conditions for this period. Temperatures during the 1st half of the calving period averaged slightly above normal (+1.2 F), and slightly below normal (-1.8 F) during the 2nd half of the calving period.

There were appreciable amounts (>0.1 in) of precipitation on 15 and 16 May; the first observations of calves were on 1-3 and 12 to 15 June. During these periods, no snow fell at Gulkana. On the calving grounds, snow fell on 12 June. Subfreezing temperatures (29-32 F) occurred overnight on 15, 16, 18, and 29 May and on 11 June.

In summary, it appears that the 1987 calving period was close to normal. The only substantial amounts of precipitation, as well as the only snow, occurred at the very end of the calving season after most of the calving losses had occurred. During future studies we will attempt to gather air temperature readings in closer proximity to the Mentasta calving grounds.

Adult and Yearling Cow Mortality

Table 8 summarizes the mortality for radio-collared cows from April 1987 to March 1988. Six of 35 radio-collared cows (17%) died during this period: two in late April or early May 1987 prior to the calving period, two during the calving period, one during summer 1987, and one during the winter of 1987-88. We determined the cause of death for only one of these six cows. A cow and newborn calf (i.e., less than 48 hours old) were found dead; a grizzly bear was feeding on them. The act of calving, as well as the presence of a newborn calf, may substantially increase a caribou's chance of being killed by predators, especially where relatively large numbers of predators are found on caribou calving grounds. The population level of wolves on the Nelchina calving grounds has apparently been low during recent years (Ballard et al. 1981); the population of brown bears may have been relatively low. Much of

the Mentasta calving area may have had high levels of wolves and brown bears.

Poachings

During the winter (i.e., 1 November 1987 to 1 April 1988), 4 poachings of caribou were documented along the Tok Cut-Off Highway from Chistochina to Mineral Lake; however, the Fish and Wildlife Protection officer for that area felt a small number of additional poachings had probably occurred. The absence of caribou from the Nabesna Road and a portion of the Tok Cut-Off Highway areas during December through February probably reduced illegal harvest of these animals.

On the winter range east of the Mentasta Mountains, a few poachings were reported by Alaska Department of Fish and Game (ADF&G) officials in Tok and the Fish and Wildlife Protection officer for that area. Since the caribou mostly remained in remote areas (i.e., away from the roads and trails frequented by residents of the area), the poaching level was probably low.

Because the number of Nelchina caribou in the MCH were equal to or greater than the number of Mentasta caribou throughout most of the winter, the apparently low level of poaching was probably further diluted. Nelchina caribou possibly accounted for one-half or more of the poaching total.

Harvest by Hunters

Historical harvest data for the MCH are summarized in Table 9. In 1987, 112 caribou were reported harvested, representing a success rate of 31% for 364 sport and subsistence hunters and a herd harvest rate of approximately 3.5%. Bulls composed 81% of this harvest. Harvest results for 1987 approximated those for the 1981-86 period (i.e., reported harvest averaged 107 caribou, bulls harvested averaged 77%, success was 30%, and the herd harvest rate was approximately 3.9%).

Population Size and Composition

Spring, postcalving, and fall sex and age composition surveys were conducted by helicopter in 1987, and a total herd census was completed during the postcalving aggregation period. Historical population and composition estimates are summarized in Table 10. A spring survey was conducted on 10 April 1987 when most of the herd was spread out on their late-winter range. The purpose of this survey was to evaluate overwinter calf survival. From a sample of 324 caribou, ratios of 77 bulls:100 cows and 45 calves:100 cows were calculated. We do not consider these to be reasonable estimates of the bull

and calf composition of this herd. Although all radio-collared Nelchina caribou had left the survey area prior to this survey, nearly all of the collared Nelchina caribou were cows. We now believe that substantial numbers of Nelchina bulls, yearlings, and calves remained in the survey area after Nelchina cows had left (see Range Overlap and Herd Interchange section, p. 16).

A postcalving sex and age composition survey was conducted on 24 June 1987. Most cows were found in relatively large postcalving aggregations on the tundra benches between the Sanford River and Boulder Creek. From a sample of 693 caribou, ratios of 6 bulls:100 cows and 18 calves:100 cows were determined. The total herd census was conducted in fixed-wing aircraft on the same day, and 2,583 caribou were counted. the proportions of calves and bulls were much lower than those observed over recent years. Over the prior 6 years, the postcalving ratios averaged 17 bulls:100 cows and 42 calves:100 cows.

A fall sex and age composition survey was flown on 12 October 1987. From a total sample of 803 caribou, ratios of 41 bulls:100 cows and 12 calves:100 cows were calculated. From the fall population data, a final fall population estimate of 3,159 was extrapolated (Table 11). We consider this estimate to be high, reflecting the high percentage of cows and low percentage of bulls in the postcalving composition survey; we believe it is the result of survey activity focused on the areas where most of the newly radio-collared cows were found. In prior years composition surveys tended to be more widespread and, therefore, more representative of herd composition.

In comparing 1987 composition and census data with those from 1981 to 1986, similarities and differences are apparent (Table 10). The fall bull:cow ratio is approximately the same as the 1981-86 average of 40:100. The postcalving and fall calf:cow ratios (18:100 and 12:100, respectively) are far below the 1981-86 averages (42:100 and 36:100). The low calf composition ratios in 1987 coincide with the low calf survivals among the radio-collared cows observed during the calving period. The reduced total herd count in 1987 also agrees with the calf composition information. The reduced calf level equates to a loss of approximately 400-500 calves, depending on whether you use the 1987 cow base or some lower estimate of the number of cows; this loss approximates the difference between the 1987 and 1986 postcalving total herd counts.

Population Model

Utilizing the 1986 total herd count, composition results from the 1987 postcalving and 1982-87 fall surveys, 1987-88 mortality rates of radio-collared cows and associated calves, and 1987 harvest data, a model of population changes and mortality was developed for the period April 1987 to April 1988 (Table 12). This model showed an annual mortality rate of approximately 16% for cows, 23% for bulls, and 69% for calves alive on 1 July. In large part because of the failure to generate a substantial 1987 calf cohort for recruitment, the model showed a total herd decline from approximately 2,800 caribou in April 1987 to approximately 2,400 caribou in April 1988. This model and the associated estimated population levels and mortality rates were based, in part, on a roughly estimated initial population size and composition and an assumed distribution of bull mortality during most of the year. An annual mortality rate for bulls was estimated, based on bull-calf recruitment and changes in the fall bull:cow ratio from one year to the next. As additional information is obtained in this study, this 1st approximation model will be expanded and refined.

Range Use

The 417 observations of radio-collared cows during the calving period provided a data base for describing home range use and movements during this period. Figure 4 is a plot of all calving locations. Home range polygons were plotted based on lines connecting peripheral observation points. These areas were based on 8 to 17 observations per individual. Home range size during this period ranged from 19 to 764 mi^2 and averaged 142 ± 64 (SD) mi^2.

During April and early May 1987 (i.e., prior to the beginning of the calving period) radio-collared cows were distributed from approximately the Sanford River north and east to the upper Copper River on timbered flats and low benches in an elevational band from 2,200 to 3,800 feet (Table 13). There was a minimal shift in mean elevational use from 2,750 feet in early April to 3,000 feet in early May. By mid-May (i.e., beginning of the calving period) the radio-collared cows were distributed over the lower and upper elevation tundra hills at elevations of 2,200 to 5,800 feet ($\bar{x}$ = 4,500 ft). Patchy snow was found throughout the upper half of this zone. Only 3 radio-collared individuals were found below an elevation of 3,600 feet. By the peak of calving (i.e., May 29) the radio-collared cows had moved to higher elevations and were distributed from 2,000 to 6,000 feet ($\bar{x}$ = 4,700 ft). Once again, 3 individuals were below 3,600 ft. Towards the end of the calving period (i.e., June 11), animals ranged from elevations of 3,200 to 6,200 feet, averaging 4,900 feet. On

12 June a substantial snowfall blanketed elevations above about 4,000 feet. All cows shifted downhill and were found in an elevational band from 3,400 to 5,000 feet ($\bar{x}$ = 4,000 ft). This snow melted off during the following week. In early July the radio-collared cows were distributed in a zone from 1,800 to 5,800 feet ($\bar{x}$ = 4,900 ft).

Radiolocation information indicates that movements during the calving period between portions of the calving range were minimal; they were much less frequent than those within calving subunits. Based on these differential movement patterns, 5 calving areas can be described (Fig. 5). For many years, the Sanford-Boulder Bench area has been recognized as the principal calving area; up to 50% of the pregnant radio-collared cows calved there. The upper Copper River area has also been recognized for a number of years as being a minor, less important calving area; up to 25% of the pregnant radio-collared cows calved there. Two of the 3 remaining locations (i.e., upper Sanford River and south of Sanford River) have been recognized as postcalving areas. The Sanford Flats has not been recognized as either a calving or postcalving area. This is the first time that calving information has been documented for these 3 areas.

The calving success of radio-collared cows within these 5 areas varied (Table 14). The principal calving area had a 7% calf survival rate (i.e., number of calves alive at the end of the calving period/number of calves born), while calf survival rates in the 4 secondary calving areas varied from 33% to 50%. Sample size in these lesser areas varied from 2 to 9 radio-collared cows.

Following the end of the calving period, the monitoring schedule for the radio-collared cows was changed to once per month. In mid-August radio-collared cows were generally found over much of the same range utilized during the calving period, namely, the tundra hills from Klawasi Creek north and east to the headwaters of the Copper River. The elevations of locations ranged from 1,800 to 7,200 feet and averaged 4,100 feet. This was the widest elevational distribution (5,400 ft) observed during the year. Thirteen radio-collared cows were located below an elevation of 3,600 feet in timbered or tall-brush habitat. By the end of September, when the snow line was at about 4,000 feet, animals had shifted downhill to the northeast; about 65% of the radio-collared animals were on the Drop Creek-Upper Copper River flats. A few animals were found on the flats from Moose Point to the Sanford River and south of the Sanford to the Nadina River. Elevational distribution extended from 2,000 to 4,200 feet ($\bar{x}$ = 3,100 ft).

By 1 November there was complete snow cover over the MCH range. About half of the radio-collared caribou were found on the east side of the Mentasta Mountains to as far as the lower Nabesna River. Most of the remaining radio-collared caribou were on the Drop Creek-Upper Copper River Flats and a few radio-collared animals were on the Sanford Flats. Animals ranged from 1,800 to 4,400 feet ($\bar{x}$ = 2,800 ft) in elevation. By midwinter 75% of the Mentasta radio-collared animals were on the east side of the Mentasta Mountains, utilizing an elevational band extending from 2,000 to 3,600 feet ($\bar{x}$ = 2,800). In late winter (i.e., early March) animals began moving west across the mountains. By the end of the 1st week in March, over 75% of the radio-collared cows were located on the west side of the Mentasta Mountains (i.e., from Drop Creek to the Little Tok River divide). The elevational distribution ranged from 2,200 to 3,600 feet ($\bar{x}$ = 2,700 ft).

It appears that much of this use is related to seasonal changes in temperature and associated snow conditions and vegetation phenology. Calving activity and summer insects are probably also important causative factors (Bergerud 1978). Further analysis of home range size, location, and changes in areas of use for specific age and reproductive cohorts is planned for the next progress report.

Range Overlap and Herd Interchange

It has been known since at least the early 1960's that Nelchina caribou occasionally winter in the same areas as the Mentasta caribou (Fig. 2). In early April 1987, 35 caribou cows were successfully radio-collared on Mentasta winter range. Having determined that none of approximately 45 Nelchina radio-collared caribou remained on this winter range, we assumed that most, if not all, of the Nelchina caribou had left the area. When 8 of the 35 newly radio-collared cows left the Mentasta range and headed west by early May, it became apparent that our assumption may have been wrong. This could have been an example of Mentasta caribou emigrating or, as we believe, a situation where a substantial number of Nelchina caribou were present during our collaring activities. If Nelchina caribou were present, many may have been young cows, since 6 of 8 cows that moved west were yearlings or 2-year-olds. Pitcher (1987) found that calving and adult cow caribou are the first to begin the spring migration towards the calving grounds, with young cows, calves and bulls bringing up the rear. Because all radio-collared Nelchina caribou in 1987 were adult cows, there was no way to determine if young Nelchina animals remained on the Mentasta range. To further clarify this situation and test our hypothesis, we will radio-collar Mentasta female calves in the near future.

If there is any appreciable amount of emigration of young Mentasta females, we should be able to document it.

By early October (i.e., rut), most Nelchina radio-collared caribou were concentrated in the upper Gakona and Chistochina River drainages. A couple of radio-collared caribou were in the midportion of these drainages, approximately 20 air miles to the north of the Copper River and the nearest radio-collared Mentasta caribou.

Movements of substantial numbers of caribou through the Mentasta Mountains and into western drainages of the Nabesna River were reported to us in mid-November. Movements of Mentasta caribou probably began as early as late October, because at that time, less than 50% of the Mentasta radio-collared cows were located on the late-fall range along the upper Copper River. Approximately 10% of the Nelchina radio-collared caribou also moved into the eastern drainages of the Mentasta Mountains during this period. This small portion of the NCH (i.e., equal in numbers to the entire MCH) remained on this eastern range in association with approximately 75% of the MCH for the next 3 months. The remainder of the MCH and a substantial number of Nelchina caribou wintered on the west side of the Mentasta Mountains. In late December approximately 25% of Nelchina radio-collared caribou were located either in GMU 11 or in the adjacent Subunit 13C. Some midwinter shifting of Nelchina caribou to the north and west occurred; by early February the percentage of Nelchina radio-collared caribou in the area had declined to 15%. Throughout the 1986-87 winter season most of the NCH (67-90%) was distributed widely in GMU 13 from the eastern Talkeetna Mountain foothills east to the Gakona River. Substantial numbers of Nelchina caribou apparently shifted back and forth from the Lake Louise flats and Gakona River drainage east onto Mentasta range a number of times during the winter.

By early March 1988 most of the Mentasta and Nelchina caribou that had been wintering to the east (GMU 12) had moved or were moving west back into GMU 11. At that time approximately 33% of the Nelchina radio-collared cows (possibly as many as 10,000 Nelchina caribou) were found in the upper Copper River area together with most of the Mentasta radio-collared cows. These Nelchina caribou remained with the MCH through mid-April. By the first of May all Nelchina radio-collared caribou had left the Mentasta range. At that time the closest Nelchina radio-collared caribou was on the Lake Louise flats, approximately 25 miles due west of the Gulkana Airport. Meanwhile, the MCH had spread out from the upper Copper River southwest to the Sanford River flats.

In October 1987 fifteen caribou from the CCH were radio-collared. This was a 1st step in an effort to document the range use and population dynamics of this small herd in GMU 12. Animals were radio-collared on a portion of their fall range in the upper Chisana River (i.e., from Cooper Pass to the Beaver Lake area). Late-winter radiolocations found these animals in the upper to mid-Chisana River area, still far removed from the Nabesna River country typically utilized by MCH and NCH. Further observations over subsequent seasons should add to our knowledge of this herd and any potential interacting or overlapping with the MCH.

CONCLUSIONS

This study was originally formulated to determine why the MCH has shown either a very low population growth rate or none at all for a number of years. Part of our initial focus was to measure their productivity through pregnancy rate, calf production, and neonatal mortality. We assumed that we would be taking a close look at the MCH's typical calving success (i.e., approximately 35-40 calves:100 cows at the end of the calving period). Instead, we observed a calving period that resulted in a postcalving production of 18 calves:100 cows. Consequently, we will closely monitor calf production and survival in 1988 to determine if the low calving success in 1987 is repeated. In the process of evaluating this mortality, we will continue to work on the other objectives of this study and attempt to answer our original question concerning long-term MCH growth trends.

The following is a list of conclusions and thoughts reached after our first year's efforts:

1. In the process of handling 39 caribou in the late winter and early spring, we were able to examine, measure, and collect blood samples from these animals. In terms of body condition at that time of year, body measurements of variously aged caribou, and blood chemistry parameters, no indications of poor physiological condition and, thus, no range-related nutritional stress were found. All of these Mentasta caribou were classified as either in fair or good condition. These caribou were comparable to Nelchina animals previously handled at approximately the same time of year. We will continue to gather this information from animals that are handled, and for comparison, we will also review similar information that has been gathered on other herds in Alaska and Canada.

2. Birth rates were derived for this herd in 1987 from two methods: (1) by observing calving and antler drop among

the radio-collared cows, and (2) from a distended-udder count of the herd. The two independently derived parturition rates were similar, approximating birth rates observed in the Nelchina herd during past studies. Productivity, as expressed through parturition rates, appeared to be relatively normal in the MCH in 1987.

3. Calving began, peaked, and ended at times similar to those established for the NCH.

4. The unusually high neonatal mortality observed in 1987 was approximately the same for radio-collared cows as it was for the herd in general. Survival of calves to the end of the calving period was dependent on when a calf was born. Calves born during the first week of the calving period had a high rate of survival. All calves born during the remaining 3 weeks of the season died. Since there was no indication of adverse weather during the middle portion of the calving period (i.e., when most calves were dying) neonatal mortality is not attributed to such environmental conditions. The distribution of mortality suggests predation of neonatal calves (i.e., less than 1 week old) by predators arriving on the calving grounds following the 1st week of the calving period.

5. Little information exists as to the cause or causes of the observed neonatal mortality. Bears, wolves, and golden eagles were observed on the calving grounds, especially during the 2nd half of the calving period; however, only a few deaths could be directly linked to predation. Only by intensively monitoring radio-collared neonatal calves can most causes of death be documented.

6. For calves of radio-collared cows occurring after the end of the calving period, mortality substantially occurred during the 2 summer months after the end of the calving period. By fall the calf mortality rate declined to a low level and remained there throughout the winter. Calf survivals in the Mentasta Herd during the postcalving period was lower than those of the NCH. A factor that may play a role this year in the overwinter survival of Mentasta calves is the presence of substantial numbers of Nelchina caribou with a much higher ratio of calves to adults mixed in with Mentasta animals during the winter. If there is any predator selection of caribou calves, a high ratio of Nelchina to Mentasta calves on the winter range should reduce the predation of Mentasta calves. On the other hand, the presence of substantial numbers of Nelchina caribou in general could reduce the level of

predation on fall Mentasta caribou (i.e., both calves and cows).

7. Adult mortality among the radio-collared cows in the MCH was higher than that typically seen in the NCH. Most of it occurred during the early spring prior to calving and during the calving period. At least some of this mortality may relate to an increased risk of predation associated with calving. Cow mortality was low during late summer, fall, and winter.

8. Modeling the population changes in numbers and composition allowed annual mortality rates to be estimated for the MCH in 1987. In addition, it provided an estimate of the change in herd size from the spring of 1987 to the spring of 1988. For the first time in a number of years, the herd declined substantially from about 2,800 to approximately 2,400 caribou.

9. Seasonal changes in the elevational range used by the radio-collared cows have been described for the period extending from the spring of 1987 to the spring of 1988. Radiolocations during the calving period suggest that there were a number of discreet calving areas. Most calving mortality occurred on the largest or principal calving area, while substantially lower mortality was associated with all of the smaller peripheral sites.

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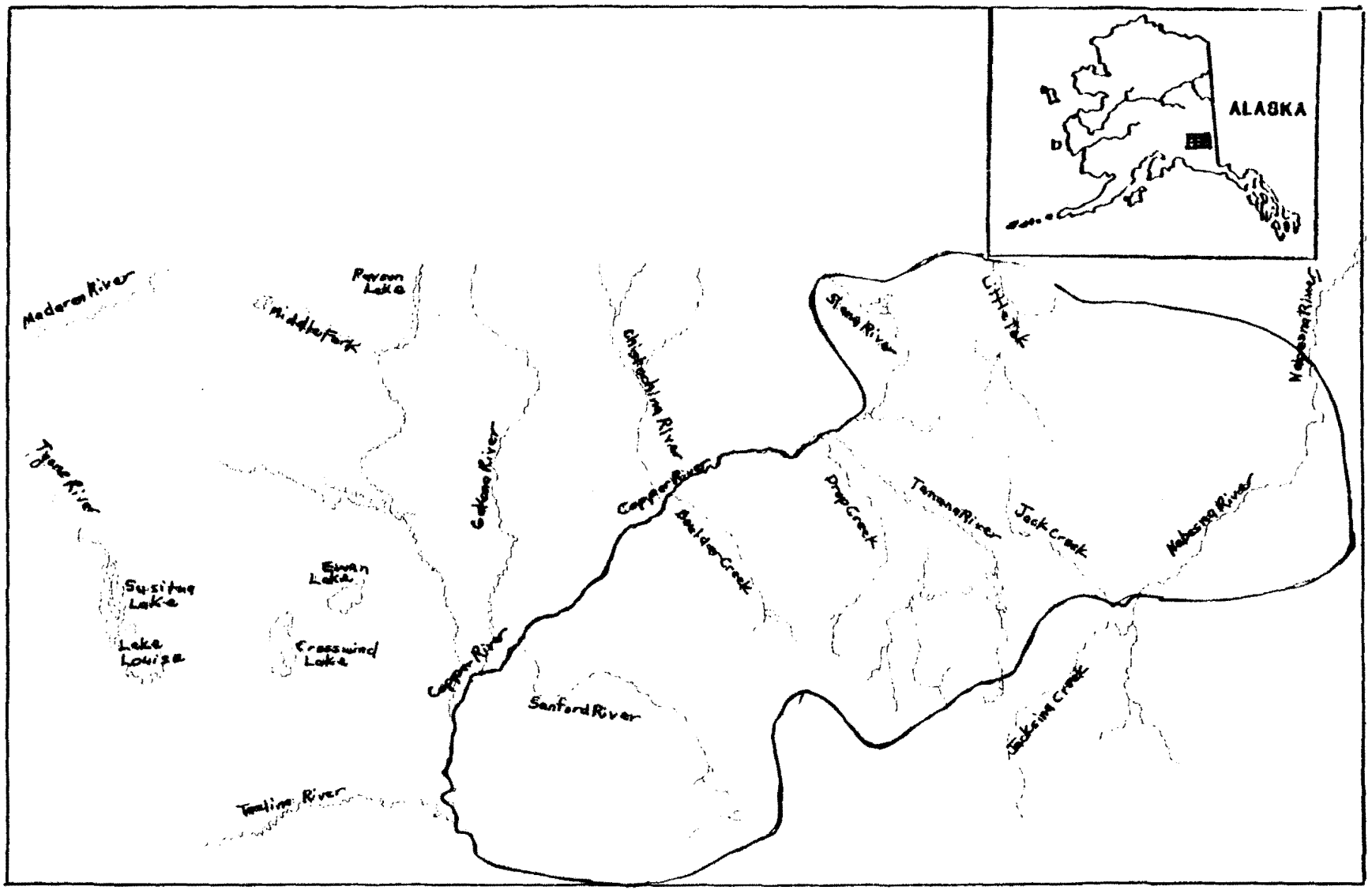

Figure 1. Mentasta caribou range.

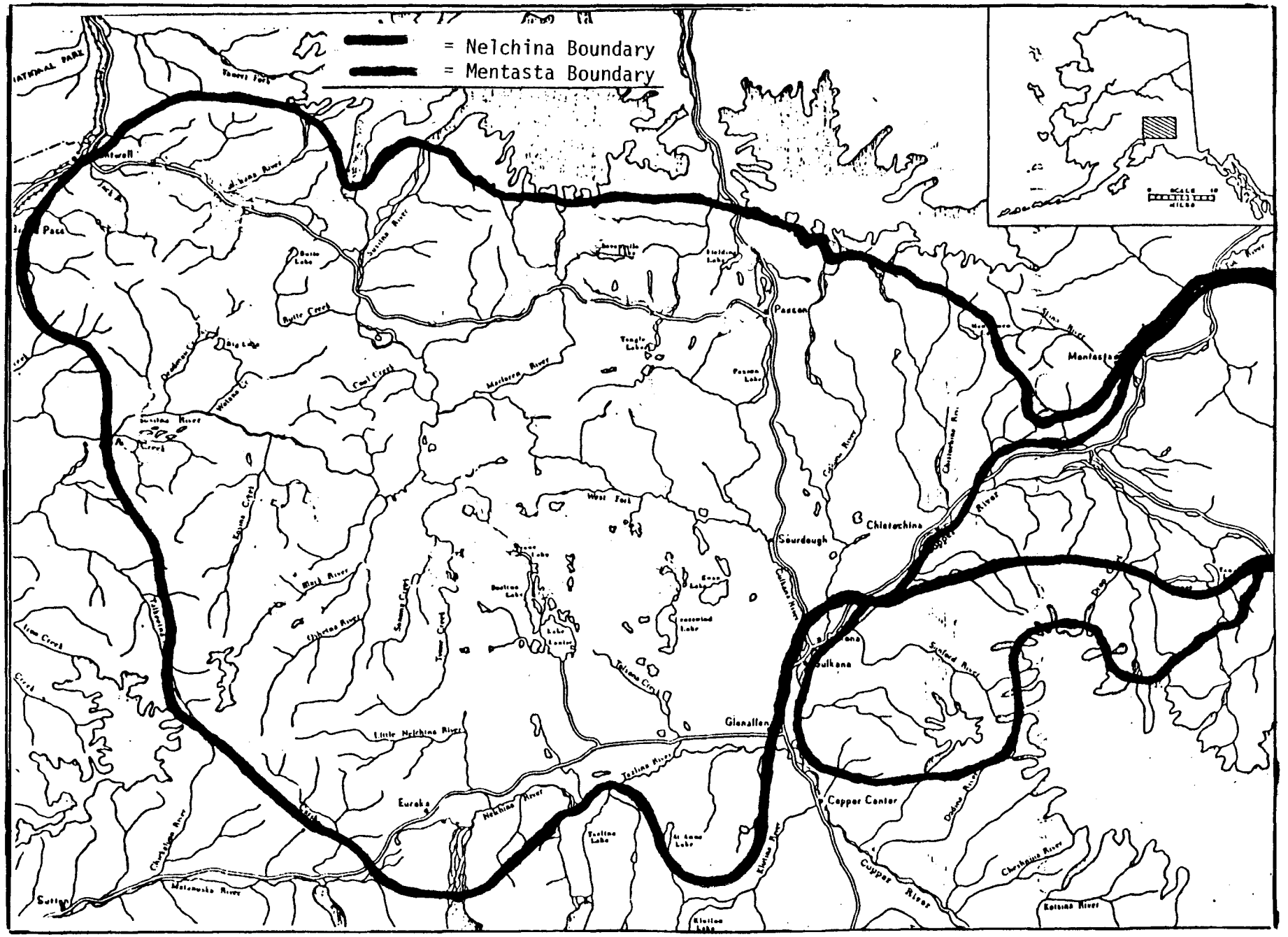

Figure 2. Nelchina and Mentasta caribou ranges.

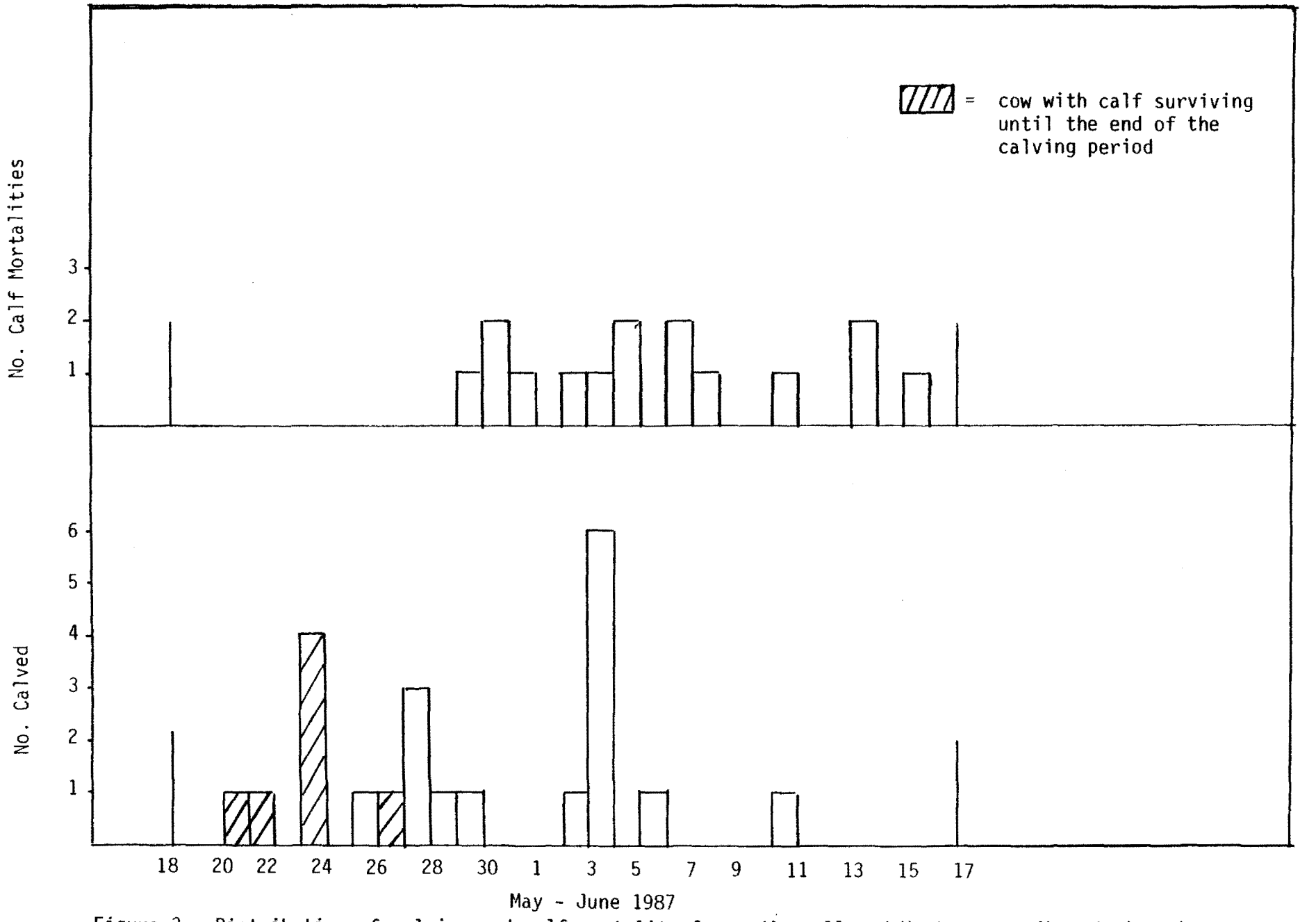

Figure 3. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period, May 18 - June 16, 1987.

Figure 4. Locations during the 1987 calving period of cow caribou radio-collared on the Mentasta range.

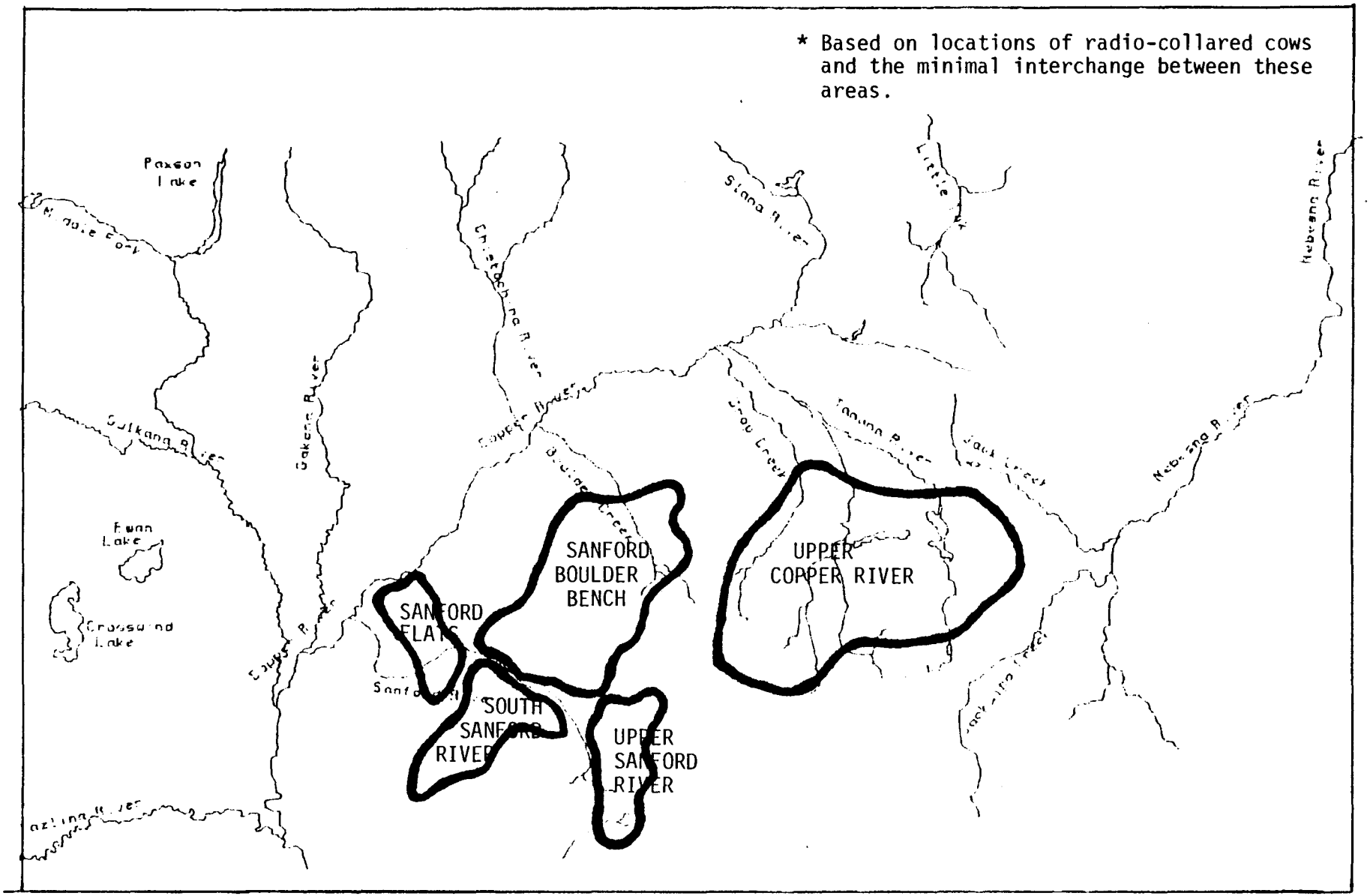

Figure 5. Portions of the Mentasta calving grounds.*

Table 1. Body measurements in inches of Mentasta caribou cows captured 7 to 10 April 1987.

	Total length	Heart girth	Hind foot length	Head length	Neck circum.	Lower jaw length	Antler (1) length	No. tines/ side
AGE								
Calf								
$\bar{x}$	60.5 (1)[a]	38.0 (1)	20.5 (1)	13.5 (1)	14.5 (1)	10.0 (1)	6.7 (2)	1.0 (2)
range	--	--	--	--	--	--	5.3-8.0	--
Yearling								
$\bar{x}$	70.3 (8)	47.3 (8)	22.7 (8)	14.9 (8)	17.2 (8)	11.2 (7)	11.7 (15)	2.1 (17)
range	66.0-75.0	44.0-50.2	22.0-23.5	13.5-15.5	16.0-18.5	10.5-12.0	6.5-17.0	1-6
2 years								
$\bar{x}$	75.3 (6)	48.8 (6)	23.1 (6)	15.6 (6)	17.9 (6)	11.8 (6)	13.3 (12)	3.0 (12)
range	69.5-78.0	47.1-50.2	22.0-24.5	15.0-16.3	17.0-19.5	11.5-12.5	10.0-17.0	1-6
3+ years								
$\bar{x}$	76.1 (20)	49.1 (19)	22.7 (20)	15.9 (29)	18.2 (18)	11.9 (18)	14.8 (30)	3.4 (33)
range	72.0-81.0	46.0-55.0	20.5-24.5	14.5-17.0	17.5-19.5	11.5-12.5	11.8-19.5	1-6

[a] parenthetical numbers = $\underline{n}$.

Table 2. Relation of various numbers of captured and radio-collared caribou pertinent to the 1987-88 Mentasta caribou study.

No. of caribou captured, April 1987		39
Captured bull & calf - not radio-collared	-	2
No. of cows radio-collared		37
No. of mortalities related to capture	-	2
No. of newly radio-collared cows for study		35
No. of cows radio-collared prior to study	+	8
Total no. of radio-collared cows		43
No. of radio-collared cows leaving Mentasta range April/May 1987	-	8
Remaining no. of radio-collared cows		35
No. of mortalities prior to calving period	-	2
No. of radio-collared Mentasta cows at beginning of calving period		33

Table 3. Calving status of radio-collared Mentasta cow caribou by age (percentage of total cows in age class).

	Age class, April 87				
	Yearling	2 years	3+ years	No age	Total
Calves observed:	0 (-)	3 (75)	18 (75)	1 (100)	22 (67)
Antlers retained (possibly pregnant):	2 (50)	1 (25)	3 (13)	0 --	6 (18)
Sub-total possibly pregnant:	2 (50)	4 (100)	21 (88)	1 (100)	28 (85)
Antlers not retained (considered not pregnant):	2 (50)	0 --	3 (12)	0 --	5 (15)
Total cows:	4	4	24	1	33

Table 4. Timing of antler drop relative to calving by cow caribou collared on the Mentasta range.

No of days between antler drop and calving	Yearlings	2 years	3+ years	No age	Total
		Cows calving from 5/20 to 6/16/87			
7-18 days prior			5		5
4-6 days prior		1			1
1-3 days prior			1		1
0 days				1	1
1-3 days after			2		2
4-6 days after		2	7		9
7-10 days after	0	0	1		1
Information concerning antler drop incomplete:			2		2
Total calved:	0	3	18	1	22
		Cows possibly calving - dropped antlers from mid-May to mid-June			
	2	1	3	0	6
		Cows probably not calving - dropped antlers from early April to early May			
When antlers dropped					
April	0	0	2	0	2
Early May	2	0	1	0	3
					5
Total					33

Table 5. Results of a helicopter survey of Mentasta caribou cows with and without calves and distended udders on 30 May 1987.

	No.	Percent total sample
No. cows with calves:	142	31
No. cows without calves but with distended udders:	155	34
Subtotal:		
Parturient cows:	297	65
No. cows without calves and without distended udders:	160	35
Total sample:	457	100

Table 6. Summary of the status of 22 calves born to radio-collared Mentasta caribou.

Date	Total no. calves alive	Total no. calves born	Calves alive as a percent of calves born	Calves/ 100 cows	No. of collared cows
05/29/87	12	13	92	36	(33)
06/02/87	9	14	64	27	(33)
06/10/87	12	22	56	38	(32)
06/16/87	7	22	32	22	(32)
07/09/87	5	22	23	16	(32)
08/10/87	4	22	18	13	(32)
01/01/88	3[a]	21	14	10	(31)
02/08/88	2	21	10	6	(31)
03/08/88	2[b]	21	10	6	(31)

[a] Cow found dead - status of calf unknown.
[b] Uncertain whether one of these cows still has a calf.

Table 7. Distribution of calving and calf mortality by week for radio-collared Mentasta caribou during the calving period 19 May-16 June 1987.

Portion of calving period	No. of calves born	Calf mortality during calving period		No of days surviving for calves dead by end of calving period	
		No.	Percent of total calves	x	(range)
May 19-26	8	1	(13)	8	(--)
May 27-June 2	6	6	(100)	4.5	(1-11)
June 3-9	7	7	(100)	4.1	(1-12)
June 10-16	1	1	(100)	3.0	(--)
Total	22	15	(68)	4.5	(1-12)

Table 8. Mortality of radio-collared Mentasta caribou, April 1987- March 1988.

	No. of radio-collared cows	(Percent of total)
Total no. radio-collared cows on 4/10/87:	35	(100)
Dead prior to calving	2	
Dead during calving	2	
Dead during summer/fall	1	
Dead during winter	1	
Total annual mortality	6	(17)
Total no. radio-collared cows alive, 4/14/88	29	(83)

Table 9. Harvest, Mentasta caribou herd, 1968-1987.

Year	Reported harvest	Percent bulls in harvest	No. permits issued	Successful rate of total permittees
1968-69[a]	304	74	--	--
1969-70[a]	288	71	--	--
1970-71[a]	846	62	--	--
1971-72[a]	1,693	45	--	--
1972	89	69	--	--
1973	81	82	--	--
1974	90	76	--	--
1975	143	72	--	--
1976[a]	236	76	--	--
1977[b]	52	75	150	35
1978	149	76	350	43
1979	99	65	350	28
1980	144	61	750	41
1981	135	84	350	39
1982	141	71	350	40
1983	90	73	350	26
1984	119	71	350	34
1985	67	76	350	19
1986 Sport	63	86	275	23
Subsis.	29	79	153	19
1987 Sport	95	81	300	32
Subsis.	17	82	64	27

[a] Portion of the harvest believed to be of Nelchina caribou.
[b] Permit-only hunting initiated.

Table 10. Population and composition estimates, Mentasta Caribou Herd, 1962 to 1987.

Year	Population estimate	Postcalving herd count	Calves/ 100 cows summer	Calves/ 100 cows fall	% calves in herd fall	Bulls/ 100 cows fall	% bulls in herd
1962	----	2,305[a]	--	--	--	--	--
1973	2,202	1,995	39	32	19	40	23
1975	----	2,456	25	--	--	--	--
1976	----	1,752	--	--	--	--	--
1977	2,711	2,262	26	27	16	42	25
1978	2,239	2,778	38	25	15	42	25
1979	----	1,834	51	--	--	--	--
1980	----	2,396	--	42	22	46	24
1981	2,819	2,621	32	40	22	43	24
1982	2,210	2,393	46	39	22	36	21
1983	2,766	2,667	36	28	16	44	25
1984	2,722	3,022	44	29	18	36	22
1985	3,140	3,108	51	46	25	41	22
1986	----	3,032	--	--	--	--	--
1987	3,159	2,583	18	12	8	41	27

[a] Winter count.

Table 11. Calculation of final fall population estimate for Mentasta caribou herd.

Summer cow composition (6/24/87):	% females = 81.0%	
Total postcalving count:	2,583	
Fall bull and calf composition (10/08/87)	bull:100 cows = 41.0	
	calves:100 cows = 11.5	
Corrected cow base: 2,583 x .81 =	2,092	
less cow harvest =	20	
	2,072	
Fall bulls: 2,072 x .41 =	849	
Fall calves: 2,072 x .115 =	238	
Total fall population estimate:	3,159	
1+ year animals =	2,921	

Table 12. Model of population changes and mortality in the Mentasta Herd, April 1987 - April 1988.

Annual Cycle of Estimated Sex and Age Composition Changes

Estimated fall/post hunting population [a, b]	Estimated spring population [c]	Estimated pre-calving [d] population	Estimated post-calving population	Estimated fall/post-hunting population	Estimated spring population
Oct. 1, 1986	April 1, 1987	May 15, 1987	July 1, 1987	Oct. 1, 1987	April 1, 1988
710 bulls (39:100 cows)	671 bulls	834 bulls	814 bulls	692 bulls (41:100 cows)	658 bulls
1,821 cows	1,751 cows	1,852 cows	1,744 cows	1,688 cows	1,621 cows
546 calves (30:100 cows)	367 calves (21:100 cows)		314 calves (18:100 cows)	203 calves (12:100 cows)	97 calves (6:100 cows)
3,077 caribou	2,789 caribou	2,686 caribou	2,872 caribou	2,583 caribou	2,376 caribou

Associated Annual Cycle of Estimated Mortality

Early spring mortality [e]	+	Calving mortality period	Summer/ early fall mortality	+	Hunt mortality	+	Winter mortality	=	Total annual mortality	Annual mortality rate
21 bulls (2.5%)		20 bulls (2.3%)	31 bulls (3.6%)		91 bulls (10.6%)		34 bulls (4.0%)		197 bulls	(23.0%)
83 cows (4.3%)		108 cows (5.6%)	35 cows (1.8%)		21 cows (1.1%)		67 cows (3.5%)		314 cows	(16.3%)
-- calves		--- calves	111 calves (35.5%)		0 calves		106 calves (33.8%)		217 calves	(69.1%)
104 caribou (3.7%)		128 caribou (4.6%)	177 caribou (6.3%)		112 caribou (4.0%)		207 caribou (7.4%)		728 caribou	(26.1%)

[a] Initial 1986 fall/post-hunting population was estimated from 1986 total herd count plus x fall composition over past 5 years. Subsequent cow and calf estimates are derived from mortality of radio-collared cows and associated calves. Bull estimates are derived from the fall bull:cow ratios in 1987 relative to the same in 1986.

[b] Mortality estimates for cows and calves from October 1986 to April 1987 are assumed to be the same as observed in 1987-88.

[c] 1986-87 overwintering calves are assumed to have a 50:50 male:female ratio, and included with bulls and cows in the estimated pre-calving populations.

[d] Neonatal calves and calf mortality prior to July 1, 1987 are not included in this model.

[e] Mortality rate in parenthesis is percentage of the total number of bulls (855) and cows (1935) in the estimated population as of April 1, 1987 and the total number of calves (314) as of July 1, 1987.

Table 13. Seasonal changes in the elevational distribution of radio-collared Mentasta caribou, 1987-88.

Time	$\bar{x}$ elevation (ft)	Range of elevation (ft)	(Width of elevational distribution band - ft)	Number of radiolocations
Early April 1987	2,800	1,800-3,400	(1,600)	22
Early May	3,000	2,200-3,800	(1,600)	14
Calving period				
Mid-May	4,500	2,200-5,800	(3,600)	28
Late May	4,700	2,000-6,600	(4,600)	15
Early June	4,800	2,000-6,200	(4,200)	17
Mid-June[a]	4,900	3,200-6,200	(3,000)	24
Early July	4,900	1,800-5,800	(4,000)	29
Mid-August	4,100	1,800-7,200	(5,400)	29
Late Sept.	3,100	2,000-4,200	(2,200)	26
Early Nov.	2,800	1,800-4,400	(2,600)	28
Late Dec.	3,100	2,000-4,000	(2,000)	33
Early Feb. 1988	2,800	2,000-3,600	(1,600)	32
Early March	2,700	2,200-3,600	(1,400)	32

[a] This sample may be skewed towards higher elevations as only cows with calves and cows still potentially pregnant were located during this part of the calving period.

Table 14. Calf survival for radio-collared cows for various portions of the Mentasta calving grounds, 1987.

Calving grounds[a]	No. calves surviving/ total cows calving[b]	(Percent)		Cows that possibly calved[c]		Total ratio	(Percent)
Upper Copper River	3/6	(50)	+	0/1	=	3/7	(43)
Sanford-Boulder Bench	1/9	(11)	+	0/5	=	1/14	(7)
Upper Sanford River	1/3	(33)		--		1/3	(33)
Sanford Flats	1/2	(50)		--		1/2	(50)
South of Sanford River	1/2	(50)		--		1/2	(50)
			+		=		
Total	7/22	(32)	+	0/6	=	7/28	(25)

[a] Calved here and calf died, or calved and spent major portion of calving period in this area and calf survived.

[b] Calves surviving = calves alive at end of calving period.

[c] Cows not observed to calf but retained antlers at least until the beginning of the calving period.

APPENDIX A

As part of this study, 39 caribou were captured and radio-collared using helicopter darting methods in early April 1987. The results of our effort are summarized and listed below. The immobilization drug carfentanil (Wildnil, Wildlife Lab, Fort Collins, CO) was used, with a dose mixture of 4.2 mg carfentanil and 5 mg acepromazine maleate (Prom Ace or Acepromazine, Fort Dodge Lab, Fort Dodge, Iowa) for all animals. With induction times generally short, we only needed to physically "bull-dog" 2 of the 39 caribou. All animals were down for short periods of time (6-24 min); during that time physiological parameters of body temperature, respiration, and muscular responses were monitored. Our only concern during the down period was the generally elevated body temperatures (104-109 F), that we attributed to relatively high ambient air temperatures (29-38 F) occurring during the capture period and/or to the effects of acepromazine maleate on the animal's ability to thermoregulate (Tobey and Ballard 1983). Because of the high body temperatures, we postponed work for 1 day when the ambient temperature exceeded 40 F.

All caribou were reversed with 520 mg naloxone hydrochloride (Naloxone, Wildlife Lab, Fort Collins, CO) (i.e., 400 mg injected IM and 120 mg SC). Thirty-six of the 39 animals stood up in 2 to 8 minutes; the remaining 3 took 10 minutes or more to stand.

Two of the 39 caribou subsequently died. We do not consider these deaths to be strictly drug mortalities; rather, we attribute them to accidents occurring prior to full physiological and behavioral recovery from the stress effects of the capture experience.

We have concluded that carfentanil is a good drug for immobilizing caribou when used with procedures similar to ours and under cool winter conditions. It is a significant improvement over our prior drug of choice, M-99, because its more potent form allows the use of smaller injection projectiles and because it more quickly and more consistently immobilizes animals. Acepromazine may not be the best attenuating tranquilizer to use when ambient temperatures exceed 30-35 degrees Fahrenheit.

Appendix B. Field condition of caribou captured in the Mentasta range, April 1987.

Animal No.	Estimated age	Condition	Antlers	Air temp	Induction time	Down time	Recovery time	Body temp	Blood PCV	Blood protein	Respiration	Drug response	Comments
1	5-6	G	Y	38	1.75	17.50	3.50	106.0	60	6.4	12	4.0	
2	3-4	G	SH1	38	4.83	12.67	3.08	106.0	58	5.6	11	4.0	
3	2	G	Y	38	7.58	17.17	4.50	108.0	50	5.4	12	3.0	
4		G	Y	38	7.58	10.83	4.00	108.0	50	7.0	52	1.0	Left her at 4 4 while still down.
5	7-9	F	SH2	37	4.42	15.58	4.00	106.0	50	4.4	13	4.0	
6	2-3	G	Y	33	5.75	18.92	12.00		54	6.4	24	3.0	
7	Yrlng.	G	Y	33	4.33	17.67	2.50		54	5.2	16	3.0	
8		G	Y	32	8.00	17.50	3.25	105.0	53	5.4	11	4.0	
9	2	G	Y	32	7.33	16.00	7.50	107.0	50	5.4	11	4.0	
10	2	G	Y	29	9.50	11.75	3.00	104.0	52	6.2	15	2.0	
11	5-6	F	Y	30	1.92	21.50	5.00	107.0	42	6.4	15	3.0	
12	1	G	Y	32	6.83	10.75	2.25	105.0	52	6.2	20	2.0	
13	10+	F	Y	33	7.50	16.00	4.75	107.0	42	5.8	15	3.0	
14	Yrlng.	G	Y	31	9.67	18.25	2.75	107.0	52	5.2	27	2.0	
15	2	G	Y	31	9.58	15.25	2.50	107.0	54	5.2		2.0	
16	Yrlng.	G	Y	33	2.67	14.83	2.50	106.0	50	4.8	16	3.0	
17	2	F	Y	33	4.92	15.58	3.50	106.0	48	4.8	13	3.0	
18	3-4	F	Y	33	2.75	20.75	5.25	107.0	48	4.8	11	3.0	
19	6-8	G	Y	33	5.50	16.25	3.00	108.0	50	5.2	27	2.0	
20	3-4	G	Y	32	3.38	12.67	11.17	106.0	49	6.4	12	3.0	
21	10+	G	Y	32	12.33	6.17	7.75	109.0	51	6.0		3.0	This caribou had to be put down.
22	7-9	F	Y	33	0.50	22.50	4.58	107.0	47	4.6	21	3.0	Down and up a number of times after initially up.
23	10+	G	Y	32	6.08	12.42	3.67	104.0	50	6.2	18	3.0	

Appendix B. continued

Animal No.	Estimated age	Condition	Antlers	Air temp	Induction time	Down time	Recovery time	Body temp	Blood PCV	Blood protein	Respiration	Drug response	Comments
24	5-6	G	Y	31	3.00	13.50	2.92	103.0	56	6.0	18	2.0	
25	5-6	G	Y	31	7.00	17.75	2.92	109.0	52	5.8	24	2.0	
26	Yrlg.	G	Y	32	13.50	10.17	3.08	109.0	38	5.0		2.0	Put down.
27	Yrlg.	G	Y	33		20.00		108.0	52	5.0		3.0	
28	6-8	G	Y	34	6.00	17.92		107.0	51	4.8		2.0	
29	Yrlg.	G	Y	35	2.25	21.25	2.67	109.0	49	5.0		3.0	
30	Yrlg.	G	Y	38	5.00	11.08	1.92		50	5.6		2.0	
31	Yrlg.	G	Y	29	3.50	23.50	2.58	107.0	48	6.2	8	5.0	Gave wrong antagonist vial.
32	2	G	Y	30	4.00	20.92	4.00	107.0	50	5.8	24	2.0	
33	3-4	G	Y	32	5.00	20.00	2.00	105.0	50	6.4	24	2.0	
34	3	G	Y	32	4.50	21.92		107.0	49	5.0	24	2.0	
35	Yrlng.	G	Y	33	4.75	17.25	2.08	107.0	49	5.6	32	2.0	
36 (10)	10+	G	Y	30	4.25	12.58	5.25	104.0	54	6.0	12	3.0	
37 (11)	3-4	G	Y	31	5.25	15.75	3.08	106.0	52	6.2	24	2.0	
38	Calf	G	Y	32	2.00	19.00	5.00	108.0	48	5.2	12	4.0	
Bull	Yrlg.	F	Y	35	5.00	19.50	5.50		50	6.4	35	3.0	

Appendix C. Calving and calf mortality dates for the collared cow caribou remaining on the Mentasta range, 1987.

Cow No.	Estimated calving date	Calving occurred within these dates	Estimated date calf lost	Loss occurred within these dates
4	6/03	(6/01-6/05)	6/07	(6/06-6/08)
9	5/27		5/31	(5/29-6/01)
10	6/03	(6/01-6/05)	6/06	(6/05-6/07)
11	5/23	(5/22-5/27)	6/28	(6/16-7/09)
13	5/27	(5/26-5/28)	5/29	(5/28-5/30)
15	6/02	(5/30-6/04)	6/13	(6/12-6/14)
18	6/10	(6/09-6/11)	6/13	(6/11-6/14)
19	5/26	(5/22-5/27)	7/25	(7/09-8/10)
21	5/20	(5/19-5/24)	Last seen with calf 1/01/88. As of 3/08/88 uncertain whether calf is alive.	
23	5/23	(5/21-5/24)	3/08/88 - ALIVE	
24	5/23	(5/22-5/24)	1/20	(1/01-2/08)
25	5/25	(5/24-5/26)	6/02	(5/30-6/04)
28	6/03	(6/01-6/05)	6/10	(6/09-6/11)
32	5/21	(5/19-5/22)	6/28	(6/16-7/09)
33	6/05	(6/01-6/05)	6/06	(6/05-6/07)
Y34	6/05	(5/24-5/29)	6/03	(6/01-6/05)
Y37	5/23	(5/19-5/27)	Last seen with calf 7/09/87. Next seen dead 1/01/88.	
Y57	6/03	(6/01-6/05).	6/04 (Cow dead also on this date)	(6/03-6/05)
N39	5/29	(5/28-5/30)	5/30	
N40	5/28	(5/27-5/29)	5/30	(5/29-6/01)
N42	6/03	(6/01-6/05)	6/15	(6/14-6/16)
N43	6/03	(6/01-6/05)	6/04	(6/03-6/05)