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Population Dynamics of the Mentasta Caribou Herd

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PROGRESS REPORT

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SUMMARY

To evaluate the population dynamics and status of the Mentasta Caribou (*Rangifer tarandus*) Herd (MCH) we studied productivity, cow and calf mortality, seasonal range use, and herd interchange. Body conditions evaluated in late winter suggest the MCH was normal, relative to the adjacent Nelchina Caribou Herd (NCH). Based on calving and antler retention surveys of radio-collared cows and a distended-udder survey of the entire herd, the proportion of cows that gave birth to calves in 1988 was estimated between 76% and 91%. This estimate is slightly higher than the parturition rate determined for the MCH in 1987; both 1987 and 1988 estimates are similar to rates determined for the NCH. Calf survival to June 15, the end of the calving period, was low relative to that observed for the NCH over the past 5 years.

The calf:cow ratio among radio-collared cows in mid-June 1988 was 29:100; a postcalving composition survey of the herd found a calf:cow ratio of 34:100. These ratios are higher than those determined for 1987 but lower than those for the prior period 1981 to 1985 when ratios averaged 42:100. Ninety percent of the 1988 calving occurred between May 18-May 31. The estimated calving peak in 1988 (May 25) was 3 days earlier than in 1987. Most calf mortality occurred during the last 3 weeks of a 4 week calving period. Limited information suggests that most deaths resulted from predation. Calf mortality for the rest of 1988 (63%) was higher than that observed in the adjacent NCH (46%). Mortality among MCH cows was estimated slightly higher (12%) than the adjacent NCH (10%). As in 1987, much of the 1988 adult mortality in the MCH (50%) occurred during the calving and post-calving periods. For the second year in a row we estimated a decline in the MCH (from approximately 3,000 precalving in spring 1987 to 2,750 in spring 1988 to 2,600 in spring 1989).

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

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BACKGROUND

Research on the population dynamics of the Mentasta Caribou Herd began in spring 1987. Background information for this study, a description of the study area, and results of last year's work have been presented (Lieb et al. 1989).

GOAL

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

OBJECTIVES

1. Evaluate the productivity of adult and yearling females.

2. Evaluate the magnitude and timing of mortality of calves, yearling females, and adult females.

3. Estimate the population size, composition, and growth rate of the MCH.

4. Determine the seasonal distribution and movements of adult and yearling female segments of the MCH.

5. Evaluate range overlap and MCH herd member interchange with the adjacent NCH and Chisana Caribou Herd (CCH).

6. Evaluate the growth and condition of Mentasta caribou, relative to other caribou herds in North America.

PROCEDURES

Capture and Marking (Job 1)

Fifteen caribou, including 5 adult females, and 10 female calves (short yearlings) were captured using helicopter net gun methods in early May 1988 (Appendix A). Eight caribou, all 4-month-old female calves, were captured by drug immobilization and helicopter in early October 1988 (Appendix B). All of these caribou were radio-collared. Body measurements and blood samples were collected from each animal upon capture. Each animal's condition was rated at the time of capture, based on subcutaneous fat and muscle tissue along the ribs and spine, pelage condition, and any detectable injuries or disease.

Packed cell volume (PCV) and total protein (TP) values were obtained from blood samples within 48 hours of collection. Blood serum was separated and frozen for additional animal condition analyses, including disease profiles and serum chemistry.

Census and Composition Counts (Job 2)

An aerial (fixed-wing) census of the herd was completed during the postcalving aggregation period in late June. A calf survival and sex and age composition helicopter survey was completed immediately after the census. We conducted a fall helicopter survey in October to further evaluate herd composition and calf survival.

Parturition Survey (Job 3)

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 this survey data and information on the distribution of calving dates for radio-collared cows, we estimated a parturition rate.

Intensive Calving Surveys (Job 4)

Radio-tracking surveys were conducted daily 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. The timing of antler drop and new antler growth of these females was also monitored. Radio-collars used in this study had a mortality, or inactive pulse rate, mode. When possible, we examined dead radio-collared caribou to determine cause of death.

Periodic Relocations (Job 5)

Thirty-two radio-collared caribou were located aerially at monthly intervals throughout the year. We plotted locations on topographic maps, and recorded associated information (i.e., date, time, habitat type, group size, and composition) on standardized forms. Telemetry was also used, and determine the proper timing of various surveys.

Nelchina Caribou Relocations (Job 6)

Forty-three radio-collared caribou in the NCH were occasionally monitored during the spring, summer and fall seasons. During the winter period when Nelchina caribou moved onto the winter range used by the MCH, both MCH and NCH animals were radio-located concurrently.

RESULTS AND DISCUSSION

Body Measurements

Body measurements were taken from 15 female caribou captured for radio-collaring in May 1988 (Table 1A) and from 7 of 8 calves captured for radio-collaring in October 1988 (Table 1B). Combining this year's spring measurement data with those of the last 2 years' measurement data provided a growth description for female caribou from 4-months to 3+-years old. With the exception of hind-foot length, all mean body measurements increased annually from calf through 3+-year age classes. Growth was +10 to 15% from the calf to yearling age class depending on the body part measured. From the yearling to 2-year age class, growth ranged from +1 to 5%, and from the 2- to 3+- year age class, +1 to 4%. Hind-foot length increased only through the 2-year age class.

As in 1987, several caribou (4 calves and 1 yearling) radio-collared in May, 1988 moved to NCH range shortly after collaring. As a result we concluded that these 5 migrants were Nelchina caribou. These animals had been measured, and the results were compared to Mentasta calf and yearling measurements. Averages for this small 1988 Nelchina subset in combination with last year's Nelchina subset show that at 11 months, Mentasta caribou calves were 2.8% larger than Nelchina calves (0 to +5.3% for the 6 body parts). No appreciable differences exist among older age classes.

Four-month-old females were radio-collared on the fall Mentasta range to provide a pool of known Mentasta juveniles, which could then be monitored for possible emigration from the Mentasta range. Measurements from these calves provided a basis for describing growth of Mentasta calves over winter (from 4-months to 10-months old). Except for neck circumference, growth continued through winter, ranging from +2.3% to +6.7% for 5 body parts. Neck circumference decreased 5.8% and may be affected by the growth and shedding of hair from fall to spring. Heart girth may also be affected in this manner.

Body Condition

We assessed the overall physical condition of captured Mentasta caribou. Appendices C and D list the field condition ranking for all captured caribou. Most spring animals were in fair condition for a time of year when caribou are generally considered in the poorest condition (Skoog 1968). The 1988 condition parameters were compared with those of animals captured in 1987. Most caribou examined in 1988 were calves, whereas only one was a calf the previous year. Thus body condition in general was worse in 1988 since calves store less fat and come out of winter in poorer shape than do older caribou. Fall caribou were all in good condition.

PCV and TP values obtained for all captured caribou are presented in Appendices C and D. In general PCV and TP values for 1988 ($\bar{x}$ = 53.7 and 5.4 respectively) were

comparable to those measured in 1987 ($\bar{x}$ = 50.4 and 5.6 respectively). Initial evaluation of these results suggests the MCH was not nutritionally stressed because the values fell within ranges considered normal for wild ungulates. Future work will include comparing Mentasta caribou condition with that of other Alaska herds.

Natality for Radio-collared Cows

During the calving period, we intensively monitored 32 radio-collared Mentasta caribou cows. We flew radio-location flights on 28 of 30 days, between 17 May and 15 June, 1988, and 430 individual radio-collared caribou observations were made. Each caribou was observed from 8 to 17 times ($\bar{x}$=13.8); most cows were observed every other day.

Table 2 summarizes the calving status of the 32 radio-collared cows. Intensive monitoring of a cow was discontinued if she lost her calf. One cow died during the calving period.

Twenty-seven cows were observed with calves, representing 84% of the radio-collared cows. The age structure of this sample under- represented the yearling and 3+-year age classes and over- represented the 2-year age class when compared to the herd's estimated age structure. We derived an 87% weighted herd parturition rate using the 3 age classes recognized by Skoog (1968) as having different parturition rates (i.e., 1-year-olds, 2-year-olds, and adult).

The unweighted parturition rate increased to 87% when an additional cow that retained its antlers into the third week of May (i.e., indicating pregnancy) and was killed by wolves before calving, was added. Then the weighted birth rate estimate for the herd became 91% - slightly higher than the 86% parturition rate estimated in 1987.

We observed the first new calf on 19 May and estimated it was born on 18 May. We observed the last new calf on 10 June and estimated it was born that day. The median calving date for radio-collared cows was 25 May. In 1987, observed calving occurred from 20 May to 10 June with a median calving date of 28 May. We believe the shift in median calving date is in part the result of better survey coverage in 1988 (28 vs. 21 survey days). Over an 8-year period Skoog (1968) observed calving in the NCH to occur from 14 May to 12 June, with 50% of the calving completed by 25 May.

Antler Drop

Skoog (1968) found that only about 5% of caribou cows without antlers at the beginning of the calving period were pregnant. He also found that practically all cows retaining antlers at the beginning of the calving period were pregnant. He concluded that the proportion of cows with antlers just before the calving period provided a reliable parturition rate estimate. In conjunction with our monitoring of Mentasta calving activity,

we checked radio-collared cows for antlers and any new antler growth developing after antler drop.

Of the 5 radio-collared cows that were not observed to have calved in 1988, 4 shed their antlers before mid-May and were considered not pregnant (Table 3). The fifth cow, still antlered, was killed and consumed by wolves on 18 May; because of the antler retention and behavior exhibited by this cow on 17 May, it was considered pregnant.

Studies indicate most pregnant caribou/reindeer retain antlers for 2 to 7 days after parturition (Flesov 1952, Lent 1965, Palmer 1934, Skoog 1968). Of the 27 radio-collared cows we observed to have calved in 1988, all retained their antlers through mid-May. Five of these 27 shed antlers before calving, with one dropping its antlers over 2 weeks before calving. The remaining 22 cows shed antlers from 3 to 13 days after calving, 11 of these 22 retained antlers for at least 8 days post-calving (Table 3).

As in 1987, our 1988 findings of antler drop timing relative to calving were substantially different from those described in the reviewed literature: a considerable percentage of calving cows shed antlers before parturition (19% in 1988; 35% in 1987). In addition, our 1988 findings differed from those of 1987, with 41% of calving cows retaining antlers for more than a week after calving in 1988. In 1987 only 5% of the calving cows retained antlers for more than a week post-calving.

Parturition Rate from Distended Udder Survey

A distended udder survey of the MCH on their calving grounds was conducted by helicopter on 27 May. We timed the survey to occur close to or after the calving peak and before the animals formed relatively large (> 25 animals) postcalving aggregations. Approximately 600 cows more than 1-year-old were evaluated; 71% of these cows (i.e., either with or without calves) had distended udders (Table 4). Based on Bergerud's (1964) work, a caribou udder becomes recognizably distended 5 days before calving and shrinks to where it is no longer obviously distended approximately 17 days after nursing ceases. This means the udder survey conducted on 27 May evaluated parturition from 10 May to 1 June. If we assume that no calving occurred before 10 May, and that 93% of the calves were born before 1 June (based on observations of the radio-collared cows), we could extrapolate a 76% parturition rate for the entire calving period. This rate is similar to the 72% parturition rate Skoog (1968) determined for the Nelchina herd females >1 year of age, but lower than the 91% parturition rate estimated for Mentasta radio-collared cows in 1988. In 1987 a 72% parturition rate was estimated from a distended udder survey conducted on 30 May, and the radio-collared cows that year provided an estimated 86% parturition rate.

The true MCH parturition rate in 1988 probably lies somewhere between 76% and 91%. The 91% estimate from the radio-collared sample was based in part on an observed 100% calving rate for 3+- year-old cows, which is somewhat higher than what normally occurs

according to the literature. This 91% parturition rate may be a small sample size error overestimation. The udder survey estimate of 76% is based on a minimum of distended udders observed and is best considered a conservative parturition estimate.

Calf Mortality

Appendix E lists all radio-collared cows we observed with a calf, and includes estimated calving dates and estimated dates calves were lost. Figure 3 depicts these data. The number of days a calf survived is a maximum estimate, partially a function of the frequency with which we monitored radio-collared cows. If the monitoring frequency had been increased from once per 2 days to once per day, the estimated length of survival probably would have decreased slightly. Table 5 summarizes the calving data to show the changes in calf composition relative to births and deaths. Based on these data for the radio-collared animals, calf numbers peaked by May 30 at 48:100 cows, and declined from 45:100 on June 7 to 29:100 by June 15.

Table 6 shows the weekly distribution of calving and calf mortality during the calving period. As in 1987, most calf mortality occurred in the last 3 weeks of calving season. Unlike that year, most calves born during the 1st week of calving did not survive until the calving period's end. As in 1987, the interval between birth and death was substantially longer for calves born early. In 1987 two-thirds of the calves that died before June 16, died within 4 days of birth; the mean length of survival was 4.5 days. In 1988 only one-half the mortality happened within 4 days of birth and the average length of survival was 7.5 days. This change may relate in part to the earlier and more concentrated calving level observed this year. Ninety percent of calving occurred over 16 days last year (May 20-June 4) versus 14 days in 1988 (May 18-31). We speculate that, with fewer neonatal calves available in the latter half of the calving period, predation may have increased on older calves.

Of the 27 radio-collared cows observed with calves in 1988, 18 (67%) lost their calves during the calving period (prior to 16 June). Of the remaining 9 calves, 2 were lost the subsequent summer and 3 disappeared during the 1987-88 winter. Since the earliest we have observed short yearlings grouped together without cows in late March/early April, we assumed it unlikely that calf-cow bonds are broken in early March. We thus concluded that calves disappearing before mid-March died. In addition, 1 radio-collared cow with a calf died during the winter and the total calf pool was reduced by one.

The overall survival to 1-year-of-age of calves living to the end of the calving period was lower than observed in the NCH in recent years. In 1988, 63% (5/8) of Mentasta calves (of radio-collared cows) surviving to the calving period's end died before the following spring; in 1987 67% died. Based on an estimated average 44% annual calf survival rate to 1-year-of-age, and an end of calving period average calf:100 cow ratio of 59 (Pitcher 1987), and assuming the same birth rate as that for the MCH in 1987 (72%),

approximately 45% ((59-(72*.44))/59) of Nelchina calves surviving to the calving period's end died before the following spring.

Causes of Calf Mortality

We suspect predation is the primary cause of newborn calf mortality. Because neonatal calves were not radio-collared, only limited information documenting cause of mortality could be obtained from observations made during fixed-wing radio-tracking surveys. Helicopter support was typically unavailable for quick access to the calving grounds. We obtained no information on the causes of death for 18 calves that disappeared during the calving period. The adult pregnant cow killed by wolves on 18/19 May may have calved shortly before death. We observed a few wolves and grizzly bears and numerous golden eagles during radio-tracking surveys of the calving grounds. Most of these observations occurred during the second half of the calving period.

Weather

Inclement weather during the calving period, especially when close to calving peak, can have a substantially negative effect on neonatal calf survival. Several authors have reported lowered calf survival coinciding with heavy snow and rain in spring (Skoog 1968, Bergerud 1983). Temperatures recorded at Gulkana airport, 30 air miles west of the principal calving area, ranged from 28°F to 79°F, and averaged 63°F maximum and 40°F minimum for this period. These average temperatures were approximately 2°F higher than normal. During the first half of the calving period temperatures averaged only slightly above normal (+0.5°F) while temperatures during the 2nd half were much higher (+3.8°F).

Appreciable precipitation amounts (>0.1 inch) were recorded on 19 and 23 May, and 3 and 15 June; none of it was snow at Gulkana. Total precipitation at Gulkana for the calving period was 1.2 inches, near normal for this time period. On the calving grounds, snow fell on 20 May above the 5,000 ft. elevation, on 30 May above 5,500 ft. and 2 June above 5,000 ft. This snowfall amounted to less than a few inches and melted within 24-48 hours. While subfreezing temperatures (28-32°F) occurred overnight at Gulkana on 3 occasions (17 and 21 May and on 4 June), we estimated such temperatures for the calving grounds on 8 nights in late May and early June. At elevations between 4,500 ft. and 6,500 ft., where most calving cows were found, minimum temperatures were estimated to average 9° to 15° cooler than at Gulkana.

In summary, the 1988 calving period was somewhat warmer than normal, and had near normal precipitation. Rain with near-freezing temperatures, and an associated small amount of snow falling at higher elevations, occurred during two 24-hour periods, May 19-20 and June 2-3. Any negative impact from these 2 short periods of inclement weather would have been on calves born on, or within 24 hours prior to these 2 days. Cows with 48-hour-old calves were relatively mobile and were observed both in 1987 and

1988 moving, in response to fresh snow, downhill to snow-free areas. Overall, we thought that weather during the 1988 calving season had little effect on calf survival.

Adult and Yearling Cow Mortality

Table 7 summarizes mortality for radio-collared cows between April 1988 and March 1989. Six of 32 radio-collared cows (19%) died during this period: one during the calving period, three during summer-fall 1988, and two during the winter of 1988-89. All 6 cows were 3+-years-old and calved in 1988. The cause of death was determined for only 1 of these 6 cows: on May 18 a cow exhibited signs that it was about to give birth, and was found dead 2 days later with a wolf feeding on the carcass. The act of calving, or the presence of a newborn calf, may substantially increase a caribou's chance of being killed by predators. In a similar incident, during 1987 calving surveys, a grizzly was observed feeding on a cow that had either been in the act of calving or had calved within the past 24 hours.

Poachings

From 1 November 1988 to 1 April 1989 no caribou poachings were documented along portions of the Nabesna Road and Tok Cutoff Highway near Slana. The absence of caribou from the area from December through February reduced the opportunity for illegal caribou harvest. On the winter range on the east side of the Mentasta Mountains there were 2 confirmed, and 4 suspected, poachings (from Mentasta Pass to the Mineral Lakes area). Since most Mentasta caribou remained in more remote areas away from roads and trails used by area residents, the poaching level was probably low. In addition, because the number of Nelchina caribou on the Mentasta Mountains/Tetlin Flats wintering area during this period greatly exceeded the number of Mentasta caribou, most poached caribou were probably from the Nelchina herd.

Harvest by Hunters

Historical harvest data for the MCH are summarized in Table 8. In 1988, 49 caribou were reported harvested for the drawing permit hunt and the registration permit subsistence hunt. This represented an overall hunter success rate of 29%. Bulls comprised 92% of the harvest. The 1988 harvest declined 56% from the 1987 harvest of 112 and was about one-half the prior 4-year mean annual harvest of 97 caribou. The decline was primarily a result of the 1988 reduction in drawing permits issued, from 300 to 100. The drawing hunt bag limit was also changed from one caribou to one bull. These regulatory changes were implemented in 1988 because of the previous year's poor calf recruitment and subsequent herd decline.

Additional hunter harvest of Mentasta animals occurred in the western portions of GMU 12, mostly near the Nabesna Road and the Nabesna and Jacksina rivers. Twenty-one caribou, all bulls, were reported taken from these areas by 51 hunters. This combined

with the permit hunt harvest resulted in a harvest of 70 caribou and represents a herd harvest rate of 2.8%.

Population Size and Composition

Spring, postcalving, and fall sex and age composition surveys were conducted by helicopter in 1988, and a total herd census was completed during the postcalving aggregation period. Historical population and composition estimates are summarized in Table 9.

We conducted a spring survey to evaluate overwinter calf survival on 4 and 5 May 1988 when most of the herd was spread out on its late-winter range. This survey and a spring radio-collaring effort was postponed until early May 1988 after finding many Nelchina caribou mixed with Mentasta animals the previous spring. From a sample of 593 caribou, we calculated ratios of 24 bulls:100 cows and 13 calves:100 cows. Four of 8 calves radio-collared the first week of May left the Mentasta range over the next 2 weeks and moved west onto the Nelchina range. Although all radio-collared Nelchina caribou left the survey area before this survey, nearly all radio-collared Nelchina caribou were cows. Apparently even this late into spring, some subadult Nelchina caribou, especially the previous year's calves, remained on the late winter/early spring range shared with Mentasta caribou. This suggested that the estimated number of 1987 Mentasta calves surviving overwinter was in the range of 6-7:100 cows, similar to the ratio of calves belonging to radio-collared cows (6:100) in early March 1988.

A postcalving sex and age composition survey was conducted on 26 and 27 June 1988. We found most cows in large postcalving aggregations on tundra benches between the Sanford River and Moose Point. From a sample of 748 caribou we determined ratios of 14 bulls:100 cows and 34 calves:100 cows. We counted 2,520 caribou during the herd census conducted via fixed-wing aircraft on 26 June. The proportions of calves and bulls counted were much higher than in 1987 when 6 bulls and 18 calves per 100 cows were estimated. Over the previous 6 years, postcalving ratios averaged 17 bulls:100 cows and 42 calves:100 cows.

We flew a fall sex and age composition survey on 9 October 1988. From a sample of 675 caribou, ratios of 43 bulls:100 cows and 18 calves:100 cows were calculated. We used these ratios together with the above post-calving information and summer/fall mortality data to extrapolate a final fall population estimate of 2,484 caribou.

In summary, the fall 1988 bull:cow ratio was approximately the same as the 1981-87 average of 40:100 (Table 9). The postcalving and fall 1988 calf:cow ratios (34:100 and 18:100, respectively) were well below the 1981-86 averages(42:100 and 36:100) though appreciably greater than the low ratios (18:100 and 12:100) seen in 1987. The moderately low calf:cow composition ratios in 1988 compare closely with that year's low survival observed for calves of radio-collared cows.

Population Model

Using total herd counts, post-calving composition survey data, harvest data, mortality data for radio-collared cows and associated calves for 1987 and 1988, and fall composition survey data for 1982-1988, we developed a model of population changes and mortality for April 1987 to April 1989 (Tables 10A & B). We estimated an annual mortality rate for bulls based on male calf recruitment and changes in the fall bull:cow ratio from one year to the next. We assumed the distribution of bull mortality over the year based on Skoog (1968). This model showed an average annual mortality rate of 12% for cows, 15% for bulls, and 68% for calves alive on 1 July. Because of low recruitment in 1987 and 1988, the model showed the Mentasta herd declining from 3,000 caribou in April 1987 to 2,600 in April 1989.

Cow caribou mortality rates based solely on the loss of radio-collared cows were 17% in 1987 and 19% in 1988. The use of these rates in the model resulted in substantially greater population size reductions than what we observed during our annual censuses. We attribute this discrepancy to small sample size error. By defining the parameter, radio-collar caribou months, as employed by Trent and Rongstad (1974) we calculated a more unbiased mortality estimate of 13.9% for the period from May 1987 through June 1989. We modified this rate further to resolve discrepancies in bull and calf:cow ratios.

Two of the starting points for the initial 1987 model (Lieb et al. 1989), estimated fall 1986 total population and fall 1986 calf:cow ratio, were modified to produce this expanded 1987-1988 model. Since we flew no composition surveys in 1986, we made no fall population estimate that year. For modeling purposes, we calculated a fall 1986 population based on average calf survival (42 calves:cows, post-calving and 27 calves:100 cows, fall) over the previous 5 years. As additional information is obtained in this study, we will further refine this preliminary model.

Seasonal Distribution

Daily aerial telemetry surveys of radio-collared cows during the calving period provided a detailed data base for describing distribution and movements. Additional monthly flights the rest of the year provided a general picture of seasonal distribution changes.

Distribution and movements observed in 1988-89 were similar to those observed over the past 5+ years. In mid-July radio-collared cows were distributed on their post-calving grounds from the Nadina River north and east to the upper Copper River in a zone from 2,600 ft. to 7,000 ft. high. Use areas included brushy and timbered flats, benches, and high tundra slopes and ridges. On warm, sunny, mid-July days we found most of these caribou near snow. In late August they were found over much of the same range used in early summer, but locations ranged from 2,200 ft. to 5,800 ft. elevation. Twenty-five radio-collared cows were located below 3,600 ft. elevation in timbered or tall brush habitat. By the third week of September, with the snow-line at 4,500 ft., animals had

shifted downhill and to the northeast, with about 60% of the radio-collared animals on the Drop Creek/Upper Copper River flats. We found some animals on the flats from Moose Point to the Sanford River and south of the Sanford to the Nadina River. Elevation distribution extended from 2,500 ft. to 4,100 ft.

By mid-October snow completely covered the Mentasta range. Caribou were spread widely over their fall range, extending from the Sanford River northeast across the Upper Copper River flats to the upper portion of the Nabesna River in Unit 12. Caribou were moving from west to east at this time. Animals ranged from 2,800 ft. to 3,400 ft. ($\bar{x}$ = 2,800 ft.) elevation. Between early December and late February three-quarters of the radio-collared animals were on the east side of the Mentasta Mountains, using an elevation band extending from 2,000 ft. to 3,600 ft. By the first week in April approximately 90% of the radio-collared cows were located on the west side of the Mentasta Mountains, most of these from Drop Creek to the Little Tok River divide. The elevation distribution ranged from 2,200 ft. to 3,800 ft.

Most range use seems related to seasonal temperature changes and associated snow conditions and vegetation phenology. Calving activity and summer insects also probably influence range selection (Bergerud 1978). Detailed analysis of home range size, location, and changes in areas of use for specific age and reproductive cohorts is planned for the final progress report.

Range Overlap

Nelchina caribou have been observed wintering in the same areas as Mentasta caribou in various years since the early 1960s. A map depicting the extent of Nelchina/Mentasta range overlap since 1982 was provided in the 1987 progress report. (Lieb et al. 1989).

In 1988-89 approximately 15,000 Nelchina caribou were on wintering areas in GMU 11 and 12, substantially larger numbers than observed in 1987-88. In early October 1988, Nelchina caribou were beginning to shift into these wintering areas. Much of the herd was located on the Lake Louise Flat, but about one-third of the herd was in GMU 13C and adjacent portions of GMU 11 where they intermixed with Mentasta caribou. Over the next month Nelchina caribou moved east across the Mentasta Mountains and into the western drainages of the Nabesna and Tok rivers, as did most Mentasta caribou. By January 1989, approximately 40% of the Nelchina herd was east of the Mentasta Mountains or immediately adjacent in GMU 11 with the Mentasta herd. In early April most of these Nelchina caribou shifted back into GMU 11 with the Mentasta herd. Nelchina spring migration began in mid-April when Nelchina cows began leaving Unit 11 and crossing the Richardson Highway from Sourdough north to Meiers Lake.

Herd Interchange

Since we began radio-collaring Nelchina and Mentasta caribou, we observed only one example of interchange between the two herds. In April 1987 we radio-collared a yearling cow (1 year 10 months old) on the Mentasta spring range. This animal shed its old antlers and grew new antlers early, indicating that it was probably not pregnant. It spent the remainder of the year and the winter of 1987-88 on Mentasta range. In early May 1988 this cow, now 2-years-old, left the Mentasta range and proceeded west to the Nelchina calving grounds where it calved and summered. In fall 1988 it moved east with other Nelchina caribou and wintered with Nelchina and Mentasta caribou to the east. Again in early May 1989 it left the Mentasta range and moved west to the Nelchina calving grounds. We don't know whether this cow was a Nelchina caribou that spent its third year (and possibly also its second year) on the Mentasta range before returning to its original range, or if it is a Mentasta cow that emigrated at the end of its second year. Since this cow calved, apparently for the first time, after moving to the Nelchina range, the question arises as to what, if any, role pregnancy played in this change in range use? Hopefully further observations of this and other radio-collared caribou will shed some light on these questions.

Because this incident was the only one among 175 radio-collared Nelchina and Mentasta female caribou from 1980-1989, this interchange could be considered rare. Additional instances occurred where radio-collared cows not found on their established calving grounds appeared there later in the year; their locations during the interim were unknown. Of the 175 female caribou radio-collared from these two herds, most were adults. Substantial numbers of juvenile/young cows were radio-collared only during the past 2 years. The incidence of interchange among young females may be higher than among adult cows.

In early April 1987, 35 caribou cows were successfully radio-collared on the Mentasta winter range. Having determined that none of the 45 Nelchina radio-collared caribou remained on this winter range, we assumed most Nelchina caribou had left. When 8 of the 35 newly radio-collared cows left the Mentasta range and headed west by early May, we concluded that a substantial number of Nelchina caribou were present during radio-collaring activities. Many of these were probably young females (6 of 8 radio-collared cows that moved west were yearlings or 2-year-olds). Pitcher (1987) found that calving and adult cow caribou initiate the spring migration towards the calving grounds, with young cows, calves and bulls following. Because all radio-collared Nelchina caribou in 1987 were adult cows, radio-collars did not help determine if young Nelchina animals remained on the Mentasta range.

In an attempt to catch only Mentasta animals, radio-collaring in 1988 was postponed until early May. Once again a telemetry survey found no Nelchina radio-collared caribou remaining on the Mentasta range. Even as late as early May (1988) young Nelchina

caribou were still present, as 4 of 8 radio-collared calves (short yearlings) and 1 of 2 radio-collared yearlings moved west to NCH range before May's end.

Because we had no real proof that the westward moving caribou radio-collared on the Mentasta range in late spring were Nelchina caribou, we radio-collared 8 4-month-old Mentasta calves in early October 1988 on the fall Mentasta range. This was done before the fall migration to the late fall/early winter range used by both Mentasta and Nelchina caribou. These calves moved north and east with the Mentasta herd in mid-October and were monitored monthly together with other radio-collared Mentasta and Nelchina caribou in the 1988-89 winter. These young Mentasta caribou will be closely monitored during spring/early summer 1989 to determine if there is any emigration.

CONCLUSIONS

This study was formulated in 1986 to determine why the MCH has shown little or no population growth for a number of years. Part of our initial focus was to measure productivity by evaluating pregnancy rate, calf production, and neonatal mortality. We expected to observe calving success typical of the MCH over the past 25 years (i.e., approximately 39 calves:100 cows at the end of the calving period). Instead we observed a postcalving production of 18 calves:100 cows in 1987 and 34 calves:100 cows in 1988. Consequently we refocused some of our effort to determine why calf survival has declined lately.

In 1989 we will continue to monitor calf production and survival closely. We will also continue to work on other objectives of this study and attempt to answer our original question concerning long-term MCH growth trends.

Conclusions and thoughts reached after our second year of study are listed here:

1. Over the past two years we handled 54 caribou in the early spring; in the process we examined, measured, and collected blood samples from these animals. In terms of body condition, body measurements of variously aged caribou at that time of year, and blood chemistry parameters, no indications of poor physiological condition or range-related nutritional stress were found. All of these Mentasta caribou were in fair to good condition. Mentasta caribou compared well to Nelchina animals handled at the same time of year. We will continue to gather this information from handled animals. We will also review and compare similar information gathered on other herds in Alaska and Canada.

2. We derived birth rates for this herd in 1987 and 1988 by two methods: (1) observing calving and antler drop among the radio-collared cows, and (2) a distended-udder count of the herd. The two independently derived parturition rates provided an estimate equal to, or greater than, birth rates observed in past

Nelchina herd studies. Productivity, expressed in parturition rates, appeared normal in the MCH the past two years.

3. Calving in 1987 and 1988 began and ended at approximately the same times as those established for the NCH. In 1988 MCH calving peaked 3 days earlier than in 1987.

4. High neonatal mortality observed in 1987 and 1988 was approximately the same for calves of radio-collared cows as it was for the herd in general. In both years most new calf mortality occurred during the last 3 weeks of the 4 week calving period. In 1988, with an earlier and more concentrated level of calving, mean length of survival was 7.5 days for calves dying during the calving season. This compares with an average survival time of 4.5 days in 1987.

5. Adverse weather appeared to contribute minimally to neonatal mortality. The timing of mortality suggests most calves were killed by predators arriving on the calving grounds after the first week of calving. We observed brown bears, wolves, and golden eagles on the calving grounds more frequently during the 2nd half of the calving period; however, only one death was directly linked to predation. Only by intensively monitoring radio-collared neonatal calves can we determine the causes of death.

6. Calf mortality after the calving period's end was evenly distributed throughout the summer, fall and winter of 1988. As in 1987, overall calf survival after the end of the 1988 calving period was substantially lower than in the NCH. We speculated that the overwinter survival of Mentasta calves would improve in the presence of large numbers of wintering Nelchina caribou with a much higher ratio of calves to adults, especially if predators selected for calves. We have insufficient observations to show if this relationship exists, but we will continue to consider this question in 1989.

7. Adult mortality among radio-collared cows in the MCH in 1988 was higher than in the NCH. Much of the mortality occurred during calving and subsequent summer/fall periods. Some of this mortality may result from an increased predation risk associated with calving and summering where relatively high predator/prey ratios exist. Since nothing suggested that winter mortality for the MCH was higher than for the NCH wintering in the same range, we believe that the observed difference in overall mortality between these two herds was attributable to the mortality occurring during the calving and post calving period. Adult mortality during this time did not appear high enough to be a major factor in the MCH decline in 1987 and 1988. The key factor was low calf survival/low annual recruitment.

8. Modeling MCH population changes in numbers and composition allowed for estimates in annual mortality rates and associated changes in herd size for 1987 and 1988. We estimated that the herd declined from approximately 3,000 to 2,600 caribou over this period.

9. Seasonal changes in the range used by radio-collared cows were briefly described for spring 1988 through spring 1989.

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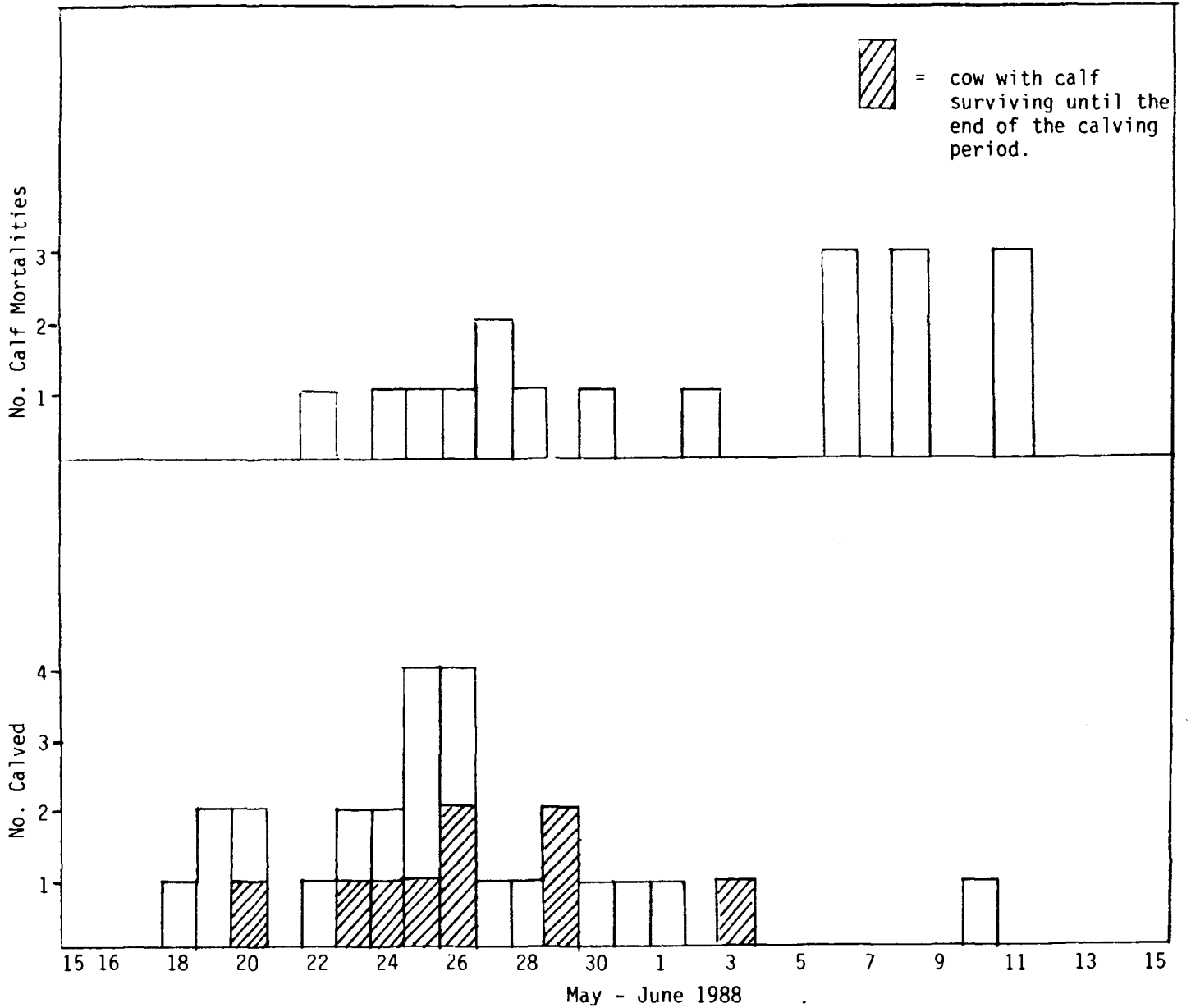

Figure 1. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period May 15 to June 16, 1988.

TABLES

Table 1A. Body Measurements (in inches) of female Mentasta caribou captured 3 to 5 May 1988.

Age		Total length	Heart girth	Hind Foot length	Head length	Neck circum.	Lower Jaw length
Calf	x	64.4(10)[a]	41.5(10)	20.7(10)	13.4(10)	14.7(10)	9.6(10)
	range	58.0-70.0	39.0-44.0	19.5-21.5	12.5-15.0	13.8-15.5	9.3-11.0
Yearling	x	72.5(2)	45.0(2)	21.5(2)	14.3(2)	16.8(2)	10.4(2)
	range	72.5	45.0	21.5	13.5-15.0	16.5-17.0	9.5-11.3
2 years	x	65.6(1)	40.0(1)	22.0(1)	15.0(2)	16.0(2)	11.1(2)
	range	--	--	--	14.5-15.5	15.0-17.0	10.8-11.5
3+ years	x	--	--	--	15.5(1)	17.0(1)	11.5(1)
	range	--	--	--	--	--	--

[a] number of caribou measured in parenthesis

Table 1B. Body Measurements (in inches) of Mentasta caribou calves captured 14 October 1988.

Age		Total length	Heart girth	Hind Foot length	Head length	Neck circum.	Lower Jaw length
4 months	x	61.0(7)[a]	39.4(7)	19.4(7)	13.1(7)	15.6(7)	9.3(7)
	range	56.8-64.5	36.0-43.0	18.5-20.0	12.0-14.0	14.5-16.5	9.0-10.0

[a] number of caribou measured in parenthesis

Table 2. Calving status of radio-collared Mentasta cow caribou by age (percentage of total cows in age class).

	Age Class, May 1, 1988[a]				
	Yearling	2 years	3+ years	No age	Total
Calf observed:	--	2 (40)	24 (96)	1 (100)	27 (84)
Antlers retained (possibly calved):	--	--	1 (4)	--	1 (3)
Subtotal Possibly calved:	--	2 (40)	25 (100)	1 (100)	28 (87)
Antlers not retained (considered as having not calved):	1 (100)	3 (60)	--	--	4 (13)
Total cows:	1	5	25	1	32

[a] yearling = 1 year 11 mos. on May 1
2 years = 2 years 11 mos. on May 1

Table 3. Timing of antler drop relative to calving by radio-collared cow caribou of the Mentasta Caribou Herd.

No. of days between antler drop and calving	Age Class, May 1, 1988				
	Yearling	2 years	3+ years	No age	Total
	For cows calving from 5/18 to 6/10 1988				
8-17 days prior to calving	--	--	5	--	5
7 days prior to 2 days after calving	--	--	--	--	--
3-7 days after calving	--	1	9	1	11
8-13 days after calving	--	1	10	--	11
Total		2	24	1	27
	Cows possibly calving - dropped antlers mid-May to mid-June				
	--	--	1	--	1
	Cows probably not calving - dropped antlers prior to mid-May				
	1	3	--	--	4
Total	1	5	25	1	32

Table 4. Results of a helicopter survey results of Mentasta caribou cows with and without calves and distended udders on 27 May 1988.

	No.	Percent of total Sample
No. cows with calves:	184	30
No. of cows without calves but with distended udders	248	41
Subtotal - parturient cows:	432	71
No. cows without calves and without distended udders	179	29
Total sample	611	100

Table 5. Summary of status of 27 calves born to radio-collared Mentasta caribou.

Date	Total no. calves born	Total no. calves alive	Calves alive as a percent of calves born	Calves: 100 cows	No. of collared cows
05/23/88	8	7	88	23	31
05/30/88	23	15	65	48	31
06/07/88	26	14	54	45	31
06/15/88	27	9	33	29	31
07/19/88	27	8	30	26	31
08/24/88	27	8	30	27	30
09/23/88	27	7	26	25	28
12/06/88	27	7	26	25	28
01/06/89	26	4[a]	15	15	27
02/21/89	26	3	12	12	26
03/30/89	26	3	12	12	26

[a] Cow found dead - status of calf unknown.

Table 6. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period 15 May - 15 June 1988.

Week of calving period	No. of calves born per week	No. of calves dying per week	No. of calves born per week that died by June 15 No.	% total calves	Mean Age at death of calves dying by June 15(in days) x	(range)
May 17-23	8	1	6	(75)	8.3	(2-19)
May 24-30	15	7	9	(60)	8.3	(2-17)
May 31-June 7	3	4	2	(67)	4.5	(2-7)
June 8-June 15	1	6	1	(100)	1.0	(---)
Total	27	18	18	(67)	7.5	(1-19)

Table 7. Mortality of radio-collared Mentasta cow caribou - April 1988-March 1989.

	No. of radio-collared cows	(Percent of total)
Total no. radio-collared cows on 4/14/88:	29	
Additional cows radio-collared 5/05/88	+ 4	
1 cow leaves Mentasta Range spring, 1988	- 1	
Total 5/15/88	32	(100)
Died during calving	1	
Died during summer/fall	3	
Died during winter	2	
Total mortality 1988-89	6	(19)
Total no. radio-collared cows alive 4/01/89	26	(81)

Table 8. Hunter harvest, Mentasta caribou herd, 1972-1988.

Year	Reported	Percent bulls	No. permits	Successful rate of total permittees
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	92	84	428	21
1987	112	81	364	31
1988[c]	49	92	168	29

[a] Portion of the harvest believed to be of Nelchina caribou.

[b] Permit-only hunting initiated in GMU 11 in 1977; from then on the harvest listed is the permit harvest only; a small number of additional Mentasta caribou have been harvested (by harvest ticket) in GMU 12 in most years.

[c] Bulls only.

Table 9. Population and composition estimates, Mentasta Caribou herd, 1962-1988.

Year	Fall 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	35	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
1988	2,484	2,520	34	18	11	43	27

[a] Winter count

Table 10a. Model of population changes and mortality in the Mentasta Caribou Herd, April 1986 - April 1987.

Annual Cycle of Estimated Sex and Age Composition Changes

Estimated fall/post hunting population[1]	Estimated spring population[2]	Estimated pre-calving population[3]	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
751 bulls	736 bulls	909 bulls	885 bulls	780 bulls	764 bulls
(39:100 cows)				(41:100 cows)	
1,927 cows	1,906 cows	2,068 cows	1,984 cows	1,900 cows	1,862 cows
511 calves	361 calves		357 calves	230 calves	112 calves
(27:100 cows)	(19:100 cows)		(18:100 cows)	(12:100 cows)	(6:100 cows)
3,189 caribou	3,003 caribou	2,977 caribou	3,226 caribou	2,910 caribou	2,738 caribou

Associated Annual Cycle of Estimated Mortality[4]

	Spring 87 mortality +	87 Calving period mortality +	Summer/ early fall 87 mortality +	87 Hunt mortality +	Winter 87/88 mortality =	Total T annual mortality	Annual mortality rate
	7 bulls(1%)	24 bulls(2%)	14 bulls(1.5%)	91 bulls(10%)	16 bulls(2%)	152 bulls	(16.5%)
	19 cows(1%)	84 cows(4%)	63 cows(3%)	21 cows(1%)	38 cows(2%)	225 cows	(11%)
	-- calves	-- calves	127 calves(33%)	0 calves	118 calves(33%)	245 calves	(69%)
	26 caribou	108 caribou	204 caribou	112 caribou	172 caribou	622 caribou	

[1] The starting point for this model is the 1986 fall/post-hunting population which was estimated from 1986 total herd count plus fall compositon trend over the past 5 years. Subsequent cow and calf estimates are derived from mortality of radio-collared cows and associated calves plus changes in seasonal herd composition. Bull estimates are derived from the fall bull:cow ratios in 1987 relative to the same in 1986.

[2] 1986-87 overwintering calves (short yearlings) are assumed to have a 50:50 male:female ratio, and included with bulls and cows in the estimated pre-calving populations.

[3] Calf Mortality prior to July 1, 1987 is not included in this model.

[4] Mortality rate in parenthesis is percentage of the total number of bulls (916) and cows (2087) in the estimated population as of April 1, 1987, and the total number of calves (357) as of July 1, 1987.

Table 10b. Model of population changes and mortality in the Mentasta Caribou Herd, April 1987 - April 1988.

Annual Cycle of Estimated Sex and Age Composition Changes

Estimated fall/post hunting population[1]	Estimated spring population[2]	Estimated pre-calving population[3]	Estimated post-calving population	Estimated fall/post hunting population	Estimated spring population
Oct. 1, 1987	April 1, 1988	May 15, 1988	July 1, 1988	Oct. 1, 1988	April 1, 1989
780 bulls	764 bulls	813 bulls	807 bulls	739 bulls	723 bulls
(41:100 cows)				(43:100 cows)	
1,900 cows	1,862 cows	1,880 cows	1,804 cows	1,723 cows	1,685 cows
230 calves	112 calves		613 calves	307 calves	202 calves
(12:100 cows)	(6:100 cows)		(34:100 cows)	(18:100 cows)	(12:100 cows)
2,910 caribou	2,738 caribou	2,693 caribou	3,224 caribou	2,769 caribou	2,610 caribou

Associated Annual Cycle of Estimated Mortality[4]

	Spring 88 mortality +	88 Calving period mortality +	Summer/ early fall 88 mortality +	88 Hunt mortality +	Winter 88/89 mortality =	Total T annual mortality	Annual mortality rate
	7 bulls(1%)	6 bulls(1%)	3 bulls(.5%)	65 bulls(8%)	16 bulls(2%)	97 bulls	(12%)
	38 cows(2%)	76 cows(4%)	77 cows(4%)	4 cows(--%)	38 cows(2%)	233 cows	(12%)
	-- calves	-- calves	306 calves(50%)	0 calves	105 calves(17%)	411 calves	(67%)
	45 caribou	82 caribou	386 caribou	69 caribou	159 caribou	741 caribou	

[1] The starting point for this model is the 1986 fall/post-hunting population which was estimated from 1986 total herd count plus fall compositon trend over the past 5 years. Subsequent cow and calf estimates are derived from mortality of radio-collared cows and associated calves plus changes in seasonal herd composition. Bull estimates are derived from the fall bull:cow ratios in 1987 relative to the same in 1986.

[2] 1986-87 overwintering calves (short yearlings) are assumed to have a 50:50 male:female ratio, and included with bulls and cows in the estimated pre-calving populations.

[3] Calf Mortality prior to July 1, 1987 is not included in this model.

[4] Mortality rate in parenthesis is percentage of the total number of bulls (916) and cows (2087) in the estimated population as of April 1, 1987, and the total number of calves (357) as of July 1, 1987.

APPENDICES

APPENDIX A: Capture of Mentasta Caribou by Net Gun, May, 1988

As part of the Mentasta caribou study, 15 caribou were captured and radio-collared in early May 1988. After unintentionally radio-collaring a number of Nelchina caribou while trying to radio-collar Mentasta caribou in April 1987 we decided to wait until early May to capture Mentasta caribou in 1988. Because of the potential for adverse drug responses under relatively high May ambient air temperatures, we also decided to capture caribou using the net gun technique. This technique was employed to capture caribou in February, 1988 on the Alaska Peninsula. The net gun, a modified Mark IV model manufactured in New Zealand, was mounted on the helicopter skid. The system worked well and was a cost-effective, hazard-free method for capturing caribou under the open conditions of the area.

Our capture effort occurred in GMU 11 along the northwest slopes of the Wrangell Mountains in a variety of habitats/terrain including heavily timbered spruce flats, moderately to sparsely forested flats and rolling hills, flats and hills of dwarf birch-willow, and gentle to moderately sloped tundra areas. Because of varying ground characteristics (hardness, roughness, openness) in most areas, caribou running speed varied also. Winds varied from calm to 15 knots; snow was absent except for some patchy snow areas on tundra above 4,000 ft. The pilot averaged 2.8 shots per animal captured. This is a much lower netting success rate than on the Alaska Peninsula. We felt the difference was related to the highly variable terrain and habitat conditions in our area. Unlike on the Peninsula, the pilot did not quickly develop skills with a small number of "practice" shots and settle down to fairly accurate shooting. Because conditions were variable, the pilot constantly had to relearn "speed" and "lead." Additionally, the net would hang up on bushes and small trees allowing the caribou to escape. The need for selectivity also contributed to the low success rate. Ten of 15 caribou we selected were female calves which meant that instead of lining up on any caribou in shooting range, we had to find and net a specific animal.

We caught 11 caribou on one day, spending 11 hours in the field. This included 2 refueling trips back to base. The remaining 4 caribou were taken in 6 hours including 1 refueling trip. We averaged approximately 1.1 hours per captured caribou. A direct comparison between this net gun operation and a typical darting operation is difficult because we selected for female calves when using the net gun. During the past 2 years we averaged 0.6 hours per captured caribou in a typical caribou capture program involving darting from helicopter. Caribou captured using the net gun technique were chased longer before capture than when captured by darting. Though once captured, handling time (downtime) without drugs was less. As might be expected, body temperature for net-gunned caribou was lower than for drugged animals ($\bar{x}$ was 104.3 °F versus 106.6 °F), while respiration was higher ($\bar{x}$ was 56 versus 19).

We had one net gun capture related mortality (7%). This compared to the 5% mortality over the past few years using drugs. The accident occurred when a running caribou and a small tree were netted simultaneously; the net was anchored and the caribou was jerked into a somersault and broke its neck.

In conclusion, for the conditions under which we operated, the cost of capturing caribou by net gun was probably less expensive than with drugging - because of the cost of the drugs. In terms of time spent, the net gun was less efficient and involved more time chasing animals and more total time per caribou captured. The net gun is of little use in heavily timbered areas. If we were not being highly selective and were working in more open areas in winter with complete snow cover providing more uniform running conditions, the net gun would probably prove more efficient. When it is necessary to capture caribou under warm conditions (spring through fall), and there is concern about detrimental effects of certain drugs on the caribou's thermoregulatory system, extra time spent using the net gun is probably warranted.

APPENDIX B: Capture of Mentasta Caribou by Carfentanil, October, 1988

Eight female Mentasta caribou calves, 4-months-old, were radio-collared in early October 1988. These calves were immobilized using the drug carfentanil. This appears to be the first immobilization of caribou this young with carfentanil.

The 8 caribou were darted by helicopter on the west slope of Mt. Drum in GMU 11. We used two dose combinations on these animals. Five calves were immobilized with 3 mg carfentanil and 3 mg acepromazine and reversed with 300 mg naloxone IM and 100 mg naloxone SC. Three calves were immobilized using 4.2 mg carfentanil and 4 mg acepromazine and reversed with 400 mg naloxone IM and 100 mg SC.

One calf was darted in the lower leg initially, darted a 2nd time in the flank, and had to be wrestled down. The remaining 7 calves were all single darted, went down well and were reversed quickly. For the 4 calves receiving the single 3.0 mg carfentanil dose, induction/down times ranged from 4.0 to 5.5 minutes and averaged 4.8 minutes. Reversal times varied from 2.0 to 2.5 minutes and averaged 2.4 minutes. For the 3 calves receiving the single 4.2 mg carfentanil dose, down times ranged from 2.5 to 4.0 minutes and averaged 3.2 minutes. These calves were reversed in an average of 2.2 minutes (range 2.0 to 2.5 minutes).

The 7 single-dosed calves were relatively well sedated and easily handled. Respiration varied from moderately to substantially depressed (10 to 18 inhalations/min). Body temperatures varied from 106.1 to 108.6 and averaged 107.2. During capture, most of these calves were separated from their mothers and other caribou they were associated with. Since these caribou were in an active migrational mode, moving steadily northeast, we were concerned about the calves' ability to rejoin their associates after drug reversal/capture recovery. One week post-capture, all 6 calves were radio-located near the Nabesna River, approximately 75 miles northeast of their capture sites. These calves were with a large portion of the Mentasta herd.

In evaluating the drug response of the calves, their behavior can be compared with that of older female caribou immobilized with carfentanil. The day before the 8 Mentasta calves were captured, we darted and radio-collared 7 Nelchina cows aged from 1.3 years to 8+ years. The drug dose used on these females was 4.2 mg carfentanil, and 4.0 mg acepromazine, the same dose used on 3 of the Mentasta calves. The reversal dose was also the same, 400 mg naloxone IM and 100 mg SC. Like the calves, the older females showed good drug response. Down times varied from 2.0 to 3.5 minutes and averaged 2.6 minutes. Reversal times varied from 2.0 to 6.0 minutes and averaged 3.7 minutes. Using the same dose combination in April 1987, we immobilized 37 Mentasta cows aged 1.9 to 10+ years. Down times ranged from 0.5 to 13.5 minutes and averaged 5.6 minutes. Reversal times ranged from 1.9 to 7.8 minutes and averaged 3.4 minutes. Drug responses were not as consistently good as seen with the fall 1988 effort, and possibly relate to such

variables as time of year, body condition, ambient air temperature, pursuit time, injection site, and received dose.

Based on our efforts, we conclude that under conditions similar to those we worked under, fall calves can readily and safely be captured using carfentanil. Appropriate doses for female calves fall in the range of 3.0 to 4.0 mg of carfentanil, suggesting that either these calves have a substantially higher tolerance for this drug (approximately 0.035-0.04 mg/lb body weight) as compared to older females (approximately 0.02 to 0.25 mg/lb body weight), or there is a relatively wide range of acceptable drug dose independent of body size or age. Since calf down times substantially declined when we went from 3.0 mg to 4.2 mg, but still averaged slightly higher than that observed for older females, calves appeared to require a drug dose (per unit body weight) of 40-100% higher than yearling to adult females to obtain a similar drug response.

Having observed body temperatures of 104° - 108° for animals captured in spring 1987, we expressed concern about capturing caribou with this drug combination at relatively high ambient air temperatures (over +30° to 35° F). During our fall 1988 effort ambient air temperatures varied from +15° to +25° F. Body temperatures still ranged from 104° to 109° F and averaged 106.5°, almost the same as in 1987. Possibly +15° to 25° F ambient air temperatures are still high for using this drug combination. More probably there is less need for concern about body temperatures in the 104°-109° range under typical capture conditions.

Because of the variable down times for caribou captured in spring 1987, we paid close attention to down times, body temperatures and degree of sedation while down during our October 1988 immobilization of 8 Mentasta calves and 7 Nelchina cows. Of the 7 Nelchina females, two were lightly sedated and had mean down times of 3.0 minutes and mean body temperatures of 108.7 F. The remaining 5 cows were well sedated. They averaged 2.4 minutes down time and 105.6° F body temperature. While down, the lightly sedated animals moved and contracted muscles continually. Caribou captured in spring 1987 shows similar differences between lightly and well sedated animals. No relationship for age or body size accounted for this observation. Such differences between lightly and well sedated caribou may be related to differences in body condition, pursuit time, injection site, or received dose. This observation suggests that animals should be dosed on the high side to reduce capture stress related to light sedation and relatively high body temperatures.

Appendix C. Field information for female Mentasta caribou captured by net gun 3 to 5 May 1988.

Animal No.	Est. Age	Condition	No. antlers present	No. antlers shed during capture	Body Temp(°F)	Respiration(PPM)	Blood PCV	Blood Protein
5	calf	good	0	2	103.2	16	54	4.6
13	2 yrs	good	2	0	--	--	--	-
14	calf	fair	1	1	--	58	60	4.6
20	calf	fair	0	1	--	150	50	5.6
36	calf	fair	0	2	--	40	50	5.4
37	yrl	fair	0	0	104.6	72	--	-
38	calf	fair	0	1	105.4	120	52	5.6
39	calf	fair	0	1-2	104.4	20	56	5.0
40	3 yrs	good	0	0	--	45	52	5.2
41	yrl	fair	1	1	--	35	52	6.8
42	calf	fair	0	2	104.6	40	54	6.0
43	calf	fair	0	1-2	103.4	16	58	5.8
44	2 yrs	fair	0	0	--	--	52	5.0
45	calf	fair	0	0	--	--	54	4.8
--[a]	calf	fair	0	2	--	--	--	-

[a] a capture mortality

Appendix D. Field Information for Mentasta caribou calves captured 14 October 1988.

Animal No.	Estimated age (mos.)	Condition	Carfentanil dose (mgs.)	Induction time (mins.)	Recovery time (mins.)	Body temp. (°F)	Level of sedation**
1930	4	Good	3.0	4.5	2.5	108.2	4
1941	4	Good	4.2	2.5	2.0	--	4
21420	4	Good	4.2	4.0	2.0	106.1	4
25076	4	Good	4.2	3.0	2.5	106.4	4
25087	4	Good	3.0	5.0	2.0	--	4
25090	4	Good	3.0*	25.0*	10.0*	--	1
27098	4	Good	3.0	4.0	2.5	108.6	4
27719	4	Good	3.0	5.5	2.5	106.7	4

* darted 2nd time after 1st hit in lower leg.

** level of sedation rated from 1 to 5, with 1 representing minimal sedation (often involving the need to wrestle the animal down) and 5 representing maximal sedation (with severely depressed respiration).

Appendix E. Calving and calf mortality dates for radio-collared cow-caribou of the Mentasta caribou herd, 1988

Cow No.	Estimated calving date	Estimated date calf lost	Calf alive end of calving period 6/15/88
1	5/19	5/25	
2	5/19	6/06	
3	5/26	6/08	
4	5/20	5/22	
6	5/23	5/26	
9	5/20	----	X
10	5/25	5/27	
11	5/18	6/06	
12	5/26	----	X
13	5/25	5/27	
15	6/03	----	X
18	6/01	6/08	
19	5/27	6/06	
21	5/30	6/11	
23	6/10	6/11	
25	5/24	5/28	
28	5/29	----	X
32	5/25	6/11	
33	5/26	----	X
34	5/24	----	X
40	5/28	5/30	
Y34	5/29	----	X
Y38	5/26	6/08	
N39	5/25	----	X
N40	5/22	5/24	
N42	5/31	6/02	
N43	5/23	----	X