Alaska Department of Fish and Game
Division of Wildlife Conservation

Research Final Report

Population Dynamics of the Mentasta Caribou Herd

by
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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 interaction. Body condition of MCH caribou in late winter was similar to that of caribou in the adjacent Nelchina Caribou Herd (NCH). Based on calving and antler retention surveys of radio-collared cows and a distended-udder survey of the herd, the proportion of cows that gave birth to calves in 1987-89 was estimated to range between 77% and 90%. These estimates are somewhat higher than rates determined for the NCH. Calf survival to 15 June, the end of the calving period, was low ($\bar{x}$ = 28 calves:100 cows in 1987-89) relative to that observed for the NCH over the past 5 years ($\bar{x}$ = 56 calves:100 cows). This Mentasta ratio is also lower than the average 42:100 Mentasta ratios for the prior period 1981-1985. From 1987 to 1989 seventy-nine percent of calving occurred between 16 May - 31 May. The estimated calving peak during this period ranged from 25 May to 28 May. 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 remainder of the year averaged 68%, substantially higher than that observed in the adjacent NCH (46%). Mortality among MCH cows was estimated to be higher (13.8%) than in the adjacent NCH (≈10%). During this study most adult female mortality in the MCH (75%) occurred during the calving and summer/fall periods. For all three years we estimated a decline in the MCH (from approximately 2,900 precalving in spring 1987 to 2,650 in spring 1988 to 2,500 in spring 1989 to 2,300 in spring 1990).

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

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INTRODUCTION

Research on the population dynamics of the Mentasta Caribou Herd began in spring 1987 and was concluded in spring 1990. Results of 1987 and 1988 work have been presented (Lieb et al. 1989; Lieb et al. 1991). This final report presents the results of work completed in 1989/90 and summarizes and discusses the results from all three years of research.

BACKGROUND

The Mentasta Caribou Herd's range (Fig. 1) is primarily in Game Management Unit (GMU) 11, from the Mentasta Mountains southwest along the north and west slopes of the Wrangell Mountains to approximately the Chetaslina River. Mentasta caribou also winter in the Little Tok, Tetlin, Nabesna, and lower Chisana river drainages of GMU 12. Much of this range fell within the boundaries of Wrangell-St. Elias National Park and Preserve when the park was established in 1980.

Standard aerial surveys of the MCH began in the early 1970s. Before this time little information was available concerning this population's status and trend. Annual censuses between 1971 and 1986 resulted in population estimates ranging from approximately 2,200 to 3,200 caribou (Bos 1974; Lieb 1984, 1986). The only trend detected over these years was a short period of growth, 1982-1985.

Summer and fall composition data suggest that recruitment, while lower than that observed in the adjacent NCH, should have been adequate for some herd growth during most of the past 10 years (Table 9). Summer postcalving composition surveys over this period have found calf:cow ratios ranging from 30 to 50 calves:100 cows. Limited data are available concerning survival to 11 months in the MCH.

The influence of range condition on the well being of the MCH is not known. Observations at a few sites over the past few years suggest that preferred lichens may be scarce in some portions of the herd's range. 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 and examined at sites used during various seasons of the year. These exclosures were to be reexamined on a regular basis, to both monitor the successional development of undisturbed exclosure vegetation and compare it to adjacent vegetation exposed to grazing and trampling effects. There is some question as to whether the 6 exclosures can adequately provide a reasonable overview of range condition and use. 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 used by Mentasta caribou may adversely affect that range. Bergerud (1980) concluded that forage carrying capacity does not begin to seriously limit

caribou population growth until densities approaching 10 caribou/mi^2 are reached. A more recent study on the George River Herd found that herd growth and vigor began to decline at approximately 5 caribou/mi^2 (Courturier 1987). On calving, summer and early fall Mentasta range caribou densities have approximated 1 caribou/mi^2 during recent years. In those years when large numbers of Nelchina caribou have moved onto the winter range utilized by Mentasta caribou, densities have reached or exceeded 10 caribou/mi^2 for periods of up to 5 months (Lieb 1986). Range inadequacies could be expressed through decline in physical condition, reduced calf production, increased calf mortality at various times of the year, increased adult mortality, and/or emigration.

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 and unexploited. The establishment of Wrangell-St. Elias National Park and Preserve (WRST) resulted in a decline in hunting and harvest of brown bears. Sport hunting was prohibited in the park portion of WRST, and subsistence hunters were prohibited from using aircraft for access into the park portion. From 1973 through 1978, prior to establishment of WRST, brown bear harvests in GMU 11 ranged from 15-27 and averaged 20 bears per year. From 1979 to 1987 harvests have ranged from 5-9 and averaged 7 bears. Observations by hunters, trappers and ADF&G personnel suggest that wolf numbers have been moderate-to-high in the northern Wrangell Mountains since the early to mid-1970s, and have increased to higher levels over the period 1985-1989, possibly related to the increasing influx of Nelchina caribou from October through May.

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 killing of calves on calving grounds of the Beverly caribou herd in the Northwest Territories; substantial numbers of wolf-killed calves were found on which there had been either no feeding or feeding only on milk curds and viscera.

Some poaching of Mentasta caribou has occurred over the past few years, primarily during winter when caribou were near the Slana-Nabesna Road or Tetlin-Northway area. We do not know whether enough caribou are taken to impact the herd substantially.

Sport and subsistence hunting of the MCH are regulated by drawing and registration permits, respectively. From 1983 to 1987, a mean 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 1986).

Severe winter conditions might contribute to 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.

Some emigration from the Mentasta range may possibly occur because relatively large numbers of Nelchina caribou regularly winter on portions of the winter range used by Mentasta caribou. Any 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 one or more 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/harvest, (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. 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)

Sixty caribou, including 33 adult females, 9 two-year-old females, 10 yearling females, and 8 female calves were captured using helicopter and drug immobilization or net gun methods during this study (Appendices A, C, and D). All of these caribou were radio-collared. Body measurements (total curvilinear length, heart girth, hindfoot length, head curvilinear length, neck circumference, and lower jaw length) 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. Body condition scores ranged from 1 to 4, with 4 indicating the best condition involving animal carrying considerable subcutaneous fat over the ribs and spine, 3 indicating good condition with enough fat and muscle tissue to cover ribs and spine, 2 indicating fair condition with ribs and spine bones palpable, and 1 indicating poor condition with ribs and spine bones prominent.

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) total count census of the herd was completed each year 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 each year in October to further evaluate herd composition and calf survival.

Parturition Survey (Job 3)

Each year a helicopter survey was conducted a few days after the peak of calving to determine the proportion of cows with distended udders. We estimated a parturition rate based on a combination of this survey data and information on the distribution of calving dates and antler retention for radio-collared cows.

Intensive Calving Surveys (Job 4)

Radio-tracking surveys were conducted daily from mid-May (i.e., onset of calving) to approximately mid-June of each year 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)

Approximately 35 radio-collared caribou in the MCH 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 to determine the proper timing of various surveys.

Nelchina Caribou Relocations (Job 6)

Approximately 45 radio-collared caribou in the NCH were monitored occasionally during spring, summer, and fall. During winter when Nelchina caribou moved onto the winter range used by the MCH, both MCH and NCH animals were radio-located concurrently.

RESULTS AND DISCUSSION

Capture and Marking

Body Measurements. Body measurements were taken from 37 female Mentasta caribou captured for radiocollaring in April 1987 (Table 1A), 15 female caribou captured for radio-collaring in May 1988 (Table 1B), and from 7 of 8 calves captured for radio-collaring in October 1988 (Table 1C). By combining these years' measurement data a growth description for Mentasta female caribou from 4-months to 3+-years old was derived. With the exception of hindfoot 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. Total lengths for the individual age classes were all significantly longer than corresponding measurements (Skoog 1968) taken from 4 caribou herds: Alaska Peninsula (95%CI=1.4±0.7,30df), Western Arctic (95%CI=6.5±0.3,140df), Fortymile (95%CI=5.3±0.5,52df), and Nelchina (95%CI=1.0±0.3,124df). Mentasta hindfoot lengths were significantly longer than for all except the Nelchina herd.

Eight caribou radio-collared in April 1987 left the Mentasta range shortly after collaring and are assumed to be Nelchina caribou. Four calves and 1 yearling caribou radio-collared in May 1988 also moved to NCH range shortly after collaring. These caribou had been measured, and the results were compared to Mentasta measurements. Averages for this

small 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); this difference was not significant. There were insufficient numbers of caribou (5) among older age classes to evaluate body size differences.

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 B, E and F 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 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. The caribou captured in fall 1988 were all in good condition.

Packed cell volume (PCV) and Total Protein (TP) values obtained for all captured caribou are presented in the appendices. The PCV and TP values for 1988 ($\bar{x}$=53.7, SE=0.7 and 5.4, 0.04 respectively) were not significantly different (95%CI, 49df) from those measured in 1987 ($\bar{x}$=50.4, SE=0.6 and 5.6, 0.3 respectively). Because of the homeostasis of blood constituents it is difficult to determine the nutritional state of a caribou herd from blood parameters. Franzmann (1983) felt the value of examining blood parameters was in providing additional factors for comparing the condition of different populations. The blood values obtained during this study are within average ranges for spring caribou (Messier et al. 1987) and suggest the Mentasta caribou herd is not nutritionally stressed.

Parturition Rate and Chronology

Monitoring Radio-collared Cows. During the 1987 calving period 33 radio-collared Mentasta cows were intensively monitored. 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, SE=0.3); most cows were observed approximately every other day. Table 2A 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.

Twenty-two cows were observed with calves, representing 67% (95% CI $\pm$ 16%) of the radio-collared cows. The age structure of this sample did not closely represent estimated

age structure of the herd; therefore, utilizing the 3 age classes recognized by Skoog (1968) as having different parturition rates (i.e. 1-year-olds, 2-year-olds, and adult), we derived a weighted minimal parturition rate of 71%. Because of the possibility of neonatal mortality occurring before we could observe a new calf, we considered additional criteria for identifying parturition and refining our estimate of parturition rate. An additional 6 cows retained their antlers into mid-May and early June (i.e., an indication of pregnancy) but were not observed with calves (see following section). When these were added to those cows observed with calves, the weighted parturition rate increased to 86%.

The first new calf was observed on 20 May 1987; the last new one on 10 June. The median calving date for the radio-collared cows was 28 May.

During the 1988 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, and made 430 individual radio-collared caribou observations. We observed each caribou from 8 to 17 times ($\bar{x}$=13.9, SE=0.7); most cows were observed every other day.

Table 2B summarizes the calving status of the 32 radio-collared cows. One cow died during the calving period. Twenty-seven cows were observed with calves, representing 84% (95% CI$\pm$ 13%) 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.

The weighted parturition rate increased to 91% 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.

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 1989 we intensively monitored 29 radiocollared Mentasta caribou cows. We flew radio-location flights on 31 of 32 days from 16 May to 16 June, and 402 individual radio-collared caribou observations were made. Each collared caribou was observed 9 to 17 times ($\bar{x}$=13.9, SE=0.4). Table 2C summarizes the calving status of the 29 radio-collared cows. Twenty-two cows were observed with calves, representing 76% (95% CI $\pm$ 16%) of the radio-collared cows. Adjusting the age classes of the radio-collared sample according to the herd's estimated age structure resulted in a weighted parturition rate of 86%. An additional 2 cows retained antlers into the calving period and were considered to the parturient. With these added in, the weighted parturition rate increased to 93%. We observed the first new calf on 17 May and estimated it to be born on 16 May. We

observed the last new calf on 14 June and estimated it was born on 13 June. The median calving date for these radio-collared cows was 26 May.

We believe that the shift in median calving date from 28 May in 1987 to 25 and 26 May in 1988 and 1989 respectively is at least in part the result of better calving period survey coverage the latter 2 years (21 survey days in 1987 vs 28 days in 1988 and 31 in 1989). Mentasta calving dates showed a high degree of synchrony between years, and our observed calving dates were essentially the same as those Skoog (1968) observed for the NCH. Over an 8-year period Skoog documented calving 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.

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 dropped antlers a few days prior to being observed on 7 April 1987, (based on blood-stained antler pedicels).

For 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: 29% (n=6) occurred 8-21 days prior to calving, 14% (n=3) 1-7 days prior to calving, 43% (n=9) 0-6 days after calving and 14% (n=3) 7-13 days after calving (Table 3A). Of the 11 "noncalving" cows in 1987, the six that shed their antlers after 15 May (between mid-May and Mid-June) probably calved.

In 1988, of the 5 radio-collared cows that were not observed to have calved, 4 shed their antlers before mid-May and were considered not pregnant (Table 3B). 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. Of the 27 radio-collared cows we observed to have calved in 1988, all retained their antlers through mid-May. Five (19%) of these 27 shed antlers 8-21 days before calving, 9 (33%) dropped antlers 0-6 days after calving and 13 (48%) 7-13 days post-calving.

In 1989 we observed 22 radio-collared cows that calved. Of these, 2 (9%) shed their antlers 8-21 days prior to calving, 1 (5%) 1-7 days prior to calving, 15 (68%) 0-6 days post-calving and 4 (18%) 7-13 days after calving. For all 3 years the percent radio-collared cows retaining antlers into the calving period ranged from 83% in 1989 to 88% in 1988 and averaged 85% (SE=2.2%).

A number of studies indicate most pregnant caribou/reindeer retain antlers for 2 to 7 days after parturition (Flesov 1952, Lent 1965, Palmer 1934, Skoog 1968). Our findings show a variable but substantial percentage of calving cows shed antlers before parturition: 43% in 1987, 19% in 1988 and 14% in 1989. A substantial percent of antler drop also occurred 7 to 13 days after calving: 14% in 1987, 48% in 1988 and 18% in 1989.

The tendency for cows to shed their antlers prior to calving appeared to be age related (significant difference between age groups, 95%CI,44df). Of the young cows (1-3 years of age) observed to calve, 11% (2/18) shed antlers prior to calving. Four of 18 (22%) mid-aged cows (4-6 years of age) shed their antlers prior to calving. And of 28 older cows (7-11+ years of age) 9 (32%) shed their antlers before calving.

Combining our 3 years of data, the median date of antler drop was plus 5 days post-calving, with 47% of antlers shed on or within 6 days after calving and 76% shed on or within 13 days after calving (Fig. 3).

Distended Udder Survey. A distended udder survey of the MCH on their calving grounds was conducted by helicopter on 30 May 1987. 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 450 cows more than 1-year-old were evaluated; 65% of these cows (i.e., either with or without calves) had distended udders (Table 4A-4C). 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 30 May evaluated parturition from 13 May to 4 June. If we assume that no calving occurred before 13 May, and that 91% of the calves were born before 4 June (based on observations of the radio-collared cows), we could extrapolate a 72% parturition rate for the entire calving period. This compares with an estimated 86% parturition rate for radio-collared Mentasta cows in 1987.

In 1988 the distended udder survey was flown on 27 May. An evaluation of 600 cows found 71% with distended udders. This extrapolates to a 76% parturition rate for the entire calving period. This compares with an estimated parturition rate for radio-collared cows of 91% in 1988.

In 1989 such a survey was conducted on 28 May. A sample of 428 cows showed 69% with distended udders. Extrapolating to cover the entire calving period resulted in an estimated parturition rate of 84%. This compares with a 93% estimated parturition rate for radio-collared Mentasta cows in 1989.

These rates, based on distended udders (72-84%), are lower than the 86-93% parturition rates estimated for the radio-collared Mentasta cows over the same 1987-89 time period (significantly different, 95%CI, 1547df), but higher on the average than the 72% parturition rate Skoog (1968) determined for the Nelchina herd females >1 year of age

in the early 1960s. Because of low MCH recruitment in 1987/88, there was a corresponding low percentage of yearling females in 1989. Thus an increase in the parturition rate in 1989 based on udder counts would be expected. If recruitment was also low in 1986/87 a corresponding higher parturition rate would be expected in 1988.

The best estimate of MCH parturition rates from 1987 to 1989 may lie somewhere between the rates determined from distended udder surveys and the rates for the radio-collared cow samples. For example, the 1988 estimate of 91% 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 estimates, on the other hand, are based on a minimum of distended udders observed and are best considered conservative parturition estimates.

Timing of Calving by Individual Cows. In addition to calving synchrony by Mentasta cow caribou to the same approximately 30-day period each year, timing by individual animals between years was examined. Of 11 cows which calved all 3 years of the study, each of 4 calved within its own individual 4 day period all 3 years. An additional six of these 11 calved within such a 4 day period in two of the 3 years. Of 14 cows which calved in 2 consecutive years of the 3 year study, 7 calved within such a 4 day period both years. This level of consistency in calving dates is higher than what could be expected from random chance and suggests one or more environmental and/or endogenous factors influencing when these cows come into estrus. In addition, there was a similar but somewhat less pronounced level of consistency in date of antler shedding for the same cows exhibiting consistency in calving date. Of the 17 cows described above for calving consistency, 14 also shed antlers within a 4 day period in either all 3 years or 2 of the 3 years. A couple of examples of this phenomenon are the following: radiocollared cow #28 calved on 3 June 1987 and 30 May 1988; both years she shed her antlers 17 days prior to calving; this cow died prior to the 1989 calving period. Radiocollared cow #Y34 calved on 27 May 1987, 29 May 1988 and 30 May 1989; she shed her antlers on 3 June 1987, 4 June 1988, and 3 June 1989.

There does not appear to be any difference in this level of consistency between age groups. One variable that did appear to influence calving date was a cow's prior year calving history. Cows that successfully kept a calf alive through the calving period showed a strong tendency to calve later the subsequent year (significant difference, 95%CI,34df). Of 10 cows who calved the year following their successful calving, 7 (70%) calved later the second year. Of 25 cows who calved the year following the loss of neonatal calf, 18 (72%) calved the same date or earlier the subsequent year.

Calf Mortality

Chronology of Calf Mortality. Appendices G, H, and I list all radio-collared cows we observed with a calf over the period 1987-89, and include estimated calving dates and

estimated dates calves were lost. Figures 3A-3C depict 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 would probably have decreased slightly. Tables 5A-5C summarize 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 from 30 May to 10 June at 38 to 48:100 cows, and declined to 21 to 29:100 by mid-June.

Tables 6A-6C show the weekly distribution of calving and calf mortality during the calving periods. In 1987 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 this period. 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. Of 22 cows observed with calves, 15 (68%) lost their young 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.

In 1988 as in 1987, most calf mortality occurred in the last 3 weeks of the calving season. Unlike in 1987, most calves born during the first 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. Unlike in 1987 when two-thirds of the calves that died before 16 June, died within 4 days of birth and the mean length of survival was 4.5 days (SE= 1.0), in 1988 only one-half the mortality happened within 4 days of birth and the average length of survival was 7.5 days (SE=1.5). This change may relate in part to the earlier and more concentrated calving observed in 1988. Of the 27 radio-collared cows observed with calves in 1988, 18 (67%) lost their calves during the calving period (prior to 15 June). Of the remaining 9 calves, 2 were lost the subsequent summer and 3 disappeared during the 1987-88 winter.

In 1989 most calving occurred during the first half of the calving period, while the majority of calving period calf mortality occurred during the second half of the calving period. Eighty-eight percent of radio-collared cows calved before 1 June, and 56% of the calves of radio-collared cows died after 1 June. As in both 1987 and 1988 the interval between birth and death was greater for calves born early. The average length of survival varied from 11.4 days for calves born the first week to 2.0 days for calves born the last week. Overall average length of survival in 1989 averaged 8.0 days (SE=1.8). Of the 22 radio-collared cows observed with calves in 1989, 16 (73%) lost their calves during the calving period. Of the remaining 6 calves all were lost by early fall.

Ninety percent of calving occurred from 20 May-4 June in 1987 versus 18-31 May in 1988 and 16-30 May in 1989. With fewer neonatal calves available in the latter half of

the 1988 and 1989 calving periods, it appears that predation increased on slightly older calves.

The overall survival to 1-year-of-age of calves living to the end of the calving period was much lower than observed in the NCH in recent years. In 1987, 67% (4/6) of Mentasta calves (of radio-collared cows) surviving to the calving period's end died before the following spring. In 1988, 63% (5/8) died, and in 1989 100% (6/6) died. For the three years, post-calving period mortality of calves-of-the-year averaged 75% (SE=16%). 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.

Calf Mortality and Predation. We believe predation is the primary cause of Mentasta newborn calf mortality during this study. 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 little information on the causes of death for calves that disappeared during the calving periods. An adult cow together with a newborn calf approximately 24 hours old were found freshly killed in early June 1987; a grizzly bear was feeding on them. Signs indicated a struggle, but did not show the presence of any predators other than the bear. The adult pregnant cow killed and eaten by wolves in late May 1988 may have calved shortly before death. We observed some wolves, grizzly bears and golden eagles during radio-tracking surveys of the calving grounds. Most of these observations occurred during the second half of the calving periods.

Calf Mortality and 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). Odde (1992) reported that the energy needs of domestic cows (*Bovidae*) increased by at least 1% for each 1°F drop in ambient air temperature below the animal's critical temperature (temperature at which the animal has to burn energy to maintain its body temperature). Under wet and/or windy conditions this relationship may be as much as 2% increase in energy expenditure per drop in degree F. For caribou the question may be how much of a drop in air temperature is required to cause a substantial increase in thermoregulatory energy expenditure. As mobile as caribou are, behavioral responses, such as moving down hill, may minimize the energy costs of inclement weather for all except neonates (less than 48 hours old) who are unable to move substantial distances.

Temperatures recorded in 1987 at Gulkana airport, 30 air miles west of the principal calving area, ranged from 29°F to 79°F, averaging 49°F (SE=0.6) during the calving period and reflecting normal temperature conditions for this period. Temperatures during

the first half of the calving period averaged slightly above normal (+1.2°F, SE=0.8), and slightly below normal (-1.8°F, SE=1.1) during the second half of the calving period. There were appreciable amounts (>0.1 in) of precipitation on 15 and 16 May. During this period no snow fell at Gulkana. On the calving ground, snow fell on 12 June after most of the calving losses had occurred. Subfreezing temperatures (29-32°F) occurred overnight on 15, 16, 18, and 29 May and on 11 June.

In 1988, Gulkana temperatures ranged from 28°F to 79°F, and averaged 53°F (SE=0.8) during the calving period, somewhat higher than normal. During the first half of the calving period temperatures averaged only slightly above normal (+0.5°F, SE=0.5) while temperatures during the second half were substantially higher (+3.8°F, SE=1.5). 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. Any negative impact from these 2 short periods of inclement weather would have been on calves born on, or within 24 hours of, 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. Subfreezing temperatures (28-32°F) occurred overnight at Gulkana on 3 occasions (17 and 21 May and on 4 June).

In 1989 temperatures at Gulkana ranged from 30°F to 69°F and averaged 50°F (SE=0.6) during the calving period, slightly higher than normal. During the first half of calving, temperatures averaged nearly 2°F above normal (SE=0.7) while in the 2nd half these were near normal (+0.2°F, SE=0.9). At 4,000 ft. elevation air temperature was recorded on the calving grounds in 1989 between 6 and 9 a.m. Twenty such recordings ranged from 32° to 51°F and averaged 42°F for the calving period. These early morning temperatures averaged 2°F higher than the minimum temperatures recorded at Gulkana (1,600 ft elevation). Substantial precipitation amounts (>0.1 inch) were recorded at Gulkana on 16, 28, and 29 May and 14 June. Three inches of snow were recorded falling on 16 May in the early morning; by mid-afternoon temperatures had risen above 50°F. Total precipitation at Gulkana during the calving period was 1.79 inches, about 3/4 inch greater than normal.

In summary, it appears that calving period temperatures were close to normal in all three years. No extended periods (greater than 2 days) of temperatures deviating from normal by ± 3°F occurred during this study. In similar manner total precipitation during the three calving periods observed deviated less than 1 inch from normal. Overall we concluded the weather could have been responsible for little if any of the poor Mentasta neonatal calf survival during the 1987, 1988, and 1989 calving seasons.

Adult Mortality

Radio-collared Cow Mortality. Tables 7A-7D summarize mortality for all radio-collared cows and for young radio-collared cows between May 1987 and April 1990. Four of 33 radio-collared cows (12.1%) died from May 1987 to April 1988: two during the calving period, one during summer 1987, and one during winter 1987-88. All four cows were 3+ years old. We determined the cause of death for only one of these cows, one with a newborn calf killed by a grizzly bear (see discussion of p.13). 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.

Four of 32 radio-collared cows (12.5%) died in 1988/89: one during the calving period, two during summer-fall, and one during the winter of 1988-89. All 4 cows were 3+-years-old and calved in 1988. We speculated that death might be predator caused for at least 1 of these cows: on 18 May 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.

In 1989, five (16.7%) of 30 radio-collared cows died: one in spring prior to calving, 3 during summer/early fall (after calving) and 1 in late winter 1989/90. Of these, 4 were 3+ years old and one was a yearling. Three of the 4 older cows calved in 1989 while one died prior to calving. The yearling did not calve. Cause of death was not determined for any of these cows; the remains of all 5 of these caribou were located and found to have been extensively fed on.

Poachings. The incidence of poaching appears in large part to be a function of time spent near roads and trails frequented by humans. Mentasta caribou in some years move out of their remote summer/early fall range and into inhabited roadside areas in the fall. Throughout winter and early spring these caribou occasionally move through such roaded areas from the Tok Cut-Off Highway and Nabesna Road east to the Alaska Highway in Canada.

During winter 1987/88, 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 ADF&G officials in Tok and the Fish and Wildlife Protection officer for that area. Because the caribou mostly remained in remote areas poaching level was probably low.

During the winters of 1988/89 and 1989/90 no caribou poachings were documented along portions of the Nabesna Road and Tok Cut-off Highway near Slana. The absence of

caribou from the area from December through February reduced the opportunity for illegal caribou harvest. During 1988/89, 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). Because most Mentasta caribou remained in more remote areas away from roads and trails used by area residents, the poaching level was probably low. In 1989/90 both Mentasta and Nelchina caribou moved further east and spent some time adjacent to the Alaska Highway in Canada. Reports suggest that a few caribou were taken from this area.

In all 3 years the number of Nelchina caribou wintering in the Mentasta Mountains/ Tetlin-Nabesna Flats exceeded the number of Mentasta caribou; poached caribou were probably primarily from the Nelchina herd.

Harvest by Hunters. Historical harvest data for the MCH are summarized in Table 8. 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 (SE=11.9), bulls harvested averaged 77% (SE=2.5%), success was 30% (SE=3.7%), and the herd harvest rate was 3.9%, SE=0.7%). In 1988, a combined harvest of 49 caribou was reported for the drawing permit hunt and the registration permit subsistence hunt, representing an overall success rate of 29% for 168 hunters. Bulls comprised 92% of the harvest. The 1988 harvest declined 56% from the 1987 harvest, primarily a result of the 1988 reduction of from 300 to 100 drawing permits issued. 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.

In 1989, under the same hunting regulations as in 1988, 45 caribou were taken during the 2 permit hunts, representing a success rate of 28% for 158 hunters. Bulls comprised 93% of the harvest.

Additional hunter harvest of Mentasta animals, under general harvest ticket hunt regulations, probably occurs in two western portions of GMU 12: in the Mentasta Mountains and in the Nabesna River drainage. Mentasta radio-collared caribou have on occasion been located in these areas in the fall. Because both Nelchina and Chisana caribou also occasionally can be found in these areas, identification of this harvest to herd source is typically not possible. Over the 3 years of this study from 12 to 21 caribou, all bulls, have been reported harvested annually from these areas.

Population Size and Composition

Standard Survey Results. Spring, postcalving, and fall sex and age composition surveys were conducted by helicopter, and a total herd census was completed during the

postcalving aggregation period. Historical population and composition estimates are summarized in Table 9.

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 most Nelchina cows had left (see Range Overlap and Herd Interchange section, p.20).

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. Unlike in prior years when only a few cows were radio-collared, composition this year focused excessively on cows and underrepresented bulls. The total herd census was conducted in fixed-wing aircraft on the same day, and 2,583 caribou were counted.

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 fall population estimate of 3,159 was extrapolated. We consider this estimate to be high, reflecting the higher than normal proportion of cows counted during the 1987 post calving composition survey. Based on a more typical postcalving proportion of cows, a fall population estimate of approximately 2,800 caribou would be derived.

The fall 1987 bull:cow ratio is approximately the same as the 1981-86 average of 40:100 (SE=1.5). The postcalving and fall calf:cow ratios (18:100 and 12:100, respectively) are far below the 1981-86 averages (42:100, SE=1.2 and 36:100, SE=2.1). 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 calves; this loss approximates the difference between the 1987 and 1986 postcalving total herd counts.

In 1988, we conducted a spring survey to evaluate overwinter calf survival on 4 and 5 May when most of the herd was spread out on its late-winter range. This survey and a spring radio-collaring effort were postponed until early May after finding, the previous April, many Nelchina caribou mixed with Mentasta animals. 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 had left the survey area before this survey, nearly all such animals 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 MCH 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 proportion of calves counted was much higher than in 1987 when 18 calves per 100 cows were estimated.

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 fall population estimate of 2,484 caribou.

Because of the problem of Mentasta and Nelchina caribou mixing on early spring Mentasta range no spring survey was conducted in 1989. A postcalving composition survey was conducted on 22 June 1989. Most animals were spread across the Sanford Bench between Boulder Creek and the Sanford River. A small number of caribou were found in the upper Sanford River and south of the Sanford. From a sample of 754 animals, ratios of 20 bulls:100 cows and 31 calves:100 cows were derived. We counted 2,687 caribou during the herd census conducted on 22 June. The proportion of calves counted was similar to that seen the previous year, higher than that observed in 1987, but substantially lower than what had been typically observed in the early 1980s.

A fall sex and age composition survey was flown on 6 October 1989. A sample of 694 caribou showed ratios of 45 bulls:100 cows and 16 calves:100 cows. These ratios together with postcalving information and summer/fall mortality estimates were used to extrapolate a fall population estimate of 2,602 caribou.

Even though the postcalving calf:cow ratios in both 1988 and 1989 were in the 30-35:100 range and substantially higher than what was observed in 1987, summer and early fall calf mortality apparently reduced calf numbers down to the 16-18:100 range going into winter. As in 1987, this resulted in minimal gross recruitment the following spring and continued net negative herd growth. As the cow base has declined over these three years bull:cow ratios have increased slightly. Although apparently subject to slightly higher annual mortality, the bulls were compensated with substantially higher percent recruitment than that associated with the cows (number of male calves recruited/number of bulls, versus same number of female calves recruited/number of 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 through 1989 and fall composition survey data for 1982-1989, we developed a model of population changes and mortality for April 1987 to April 1990 (Tables 10A-10C). 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). Over the period 1987-89 this model showed an annual mortality rate ranging from 11-12% for cows, 12-16% for bulls, and 69-78% for calves alive on 1 July. With low recruitment in all three years, the model showed the Mentasta herd declining from approximately 2,900 caribou in April 1987 to 2,300 in April 1990.

Cow caribou annual mortality rates based solely on the loss of radio-collared cows ranged from 12 to 17% from 1987 to 1989. These estimates were refined by utilizing radio-collar caribou months as employed by Trent and Rongstad (1974); this resulted in the calculation of an annual mortality estimate of 13.8% (95%CI,86df=±0.8%) for the period from May 1987 through April 1990. The use of these rates in the model resulted in slightly greater population size reduction than annual censuses indicated. This discrepancy may be due to small sample size error. For modeling purposes, mortality rates were derived from census and composition information.

Two of the parameters needed for the initial 1987 model (Table 10A), were estimated fall 1986 total population and fall 1986 calf:cow ratio. Because 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 (25 calves:100 cows, fall) over the previous 5 years.

Range Use

Seasonal Distribution. Daily aerial telemetry surveys of radio-collared cows during the calving period provided the basis 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 from 1987-90 were similar to those observed over the prior 5+ years. During April and early May (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.

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. By the peak of calving in late May the radio-collared cows had moved to somewhat higher

elevations and were distributed from 2,000 to 6,000 feet ($\bar{x}$ = 4,700 ft), with only a few individuals below 3,600 ft. Towards the end of the calving period in mid-June, animals ranged from elevations of 3,200 to 6,200 feet, averaging 4,900 feet.

By 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 1,800 ft to 7,200 ft. 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 elevation of locations ranged from 2,200 ft. to 5,800 ft. elevation. By mid-to-late September, with the snow-line dropping, animals shifted downhill and to the northeast. Typically the majority of animals were found on the Drop Creek/Upper Copper River flats. We also found animals on the flats from Moose Point to the Sanford River and south of the Sanford to the Chetaslina River. Elevation distribution extended from 2,000 ft. to 4,000 ft ($\bar{x}$ = 3,100 ft).

By mid- to late 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 usually moving from west to east at this time. Animals ranged from 1,800 ft. to 4,400 ft. ($\bar{x}$ = 2,800 ft.). During this study between early December and late February most 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 in all three years 90% or more of the radio-collared cows had moved back and were located on the west side of the Mentasta Mountains, most of these from Drop Creek to the Little Tok River divide. This late winter/spring shift began as early as the third week in February. The elevation distribution by late March ranged from 2,200 ft. to 3,800 ft.

Range use appeared to be most closely related to seasonal temperature changes and associated snow conditions and vegetation phenology. Calving activity and summer insects also probably influence seasonal range selection (Bergerud 1978).

Range Overlap. Nelchina caribou have been observed wintering in the same areas as Mentasta caribou in various years since the early 1960s.

During the rut in early October 1987, most Nelchina radio-collared caribou were concentrated in the upper Gakona and Chistochina River drainages. A couple of radio-collared caribou were in the mid-portion of these drainages, approximately 20 air miles north of the Copper River and the nearest radio-collared Mentasta caribou.

Movements of substantial numbers of Mentasta caribou through the Mentasta Mountains and into western drainages of the Nabesna River began in late October. At that time, less than 50% of the Mentasta collared cows remained to the west 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 1987-88 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 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 1 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, (north and east of the Gulkana Airport).

In 1988-89 approximately 15,000 Nelchina caribou used 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. 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.

In 1989-90 by early October both Mentasta and Nelchina caribou were moving east out of GMUs 11 and 13(C). By late October most Mentasta caribou were found from the Little Tok River east to the Tetlin and Nabesna rivers. At the same time approximately 75% of the Nelchina herd (30,000 caribou) was spread out from the Nabesna River to the Canadian border, with another 20% (8,000) in the eastern Mentasta Mountains. By early December the Mentasta herd had spread further east and was fully intermixed with the

Nelchina herd. Most of both herds wintered in an area extending from the Nabesna River east to Beaver Creek in Canada and from the base of the Nutzotin Mountains north to the Alaska Highway. Movements back to the west began in late March and early April 1990.

In October 1987, 15 caribou from the Chisana caribou herd (CCH) were radio-collared. This was a first step in an effort to evaluate the range use and population dynamics of this small herd in GMU 12. These animals calve and summer in the upper reaches of the Chisana and White rivers. Late-winter 1987/88 radiolocations found these animals in the upper to mid-Chisana River area, substantially removed from the Nabesna River country to the north that is typically utilized by MCH and NCH.

During winter 1988/89 radio-collared Chisana caribou were monitored on several occasions. In mid-February an estimated 50% or more of the herd was found along the northern base of the Nutzotin Mountains from Stuver Creek to the Canadian border. Most of the eastern Mentasta and Nelchina caribou were spread out across the Nabesna flats as far east as Jatahmund Lake at this time. Any overlap with Chisana caribou probably occurred in December or January when some Nelchina and Mentasta caribou were further east near the Chisana River. In early March one Chisana radio-collared cow was located with a small group of caribou in Jack Creek drainage west of Devil's Mountain Lodge. Formerly believed to be Mentasta range, this apparently is an area of occasional overlap.

During winter 1989/90 Chisana animals were mostly in the upper reaches of the Chisana River and White River drainages in early winter. A few animals were near the Chisana River where it flows out of the hills onto the flats. By mid-winter a major portion of Chisana caribou had shifted northeast into the upper and middle portions of Beaver Creek (Canada), where they remained through early April. During much of this period substantial numbers of Mentasta and Nelchina caribou could be found along the Canadian border from Mirror Creek south to Beaver Creek, overlapping at least some of the Chisana use area.

During this 1987-1990 period radio-collared caribou from the Fortymile herd were also monitored wintering on and immediately adjacent to the greater Tetlin-Nabesna Flat. As with the Chisana herd, there had been little evidence of substantial wintering activity in this area prior to 1988. It was believed that for many years (at least since the high herd numbers of the 1960s) the Fortymile, Chisana and Nelchina/Mentasta groups occupied mutually exclusive winter ranges. Movements of substantial numbers of Fortymile animals into Gardiner Creek, of Chisana caribou into Beaver and Scottie Creek and the northern Chisana River country, and of Nelchina and Mentasta caribou across the Chisana River and the Alcan Highway in 1988/89 and 1989/90 has potentially created an international wintering grounds utilized by four overlapping caribou herds.

Herd Interchange. In early April 1987 we concluded, after determining that none of the 45 Nelchina radio-collared caribou remained on the Mentasta winter range, that most Nelchina caribou had left. We then radio-collared 35 caribou cows on this winter range.

When 8 of these newly radio-collared cows left the Mentasta range and headed west by early May, it appeared that a substantial number of Nelchina caribou had been present during radio-collaring activities. Most 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 adult calving 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 had not helped 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 radio-collared Nelchina caribou remaining on the Mentasta range. After 4 of 8 newly radio-collared calves (short yearlings) and 1 of 2 newly radio-collared yearlings moved west to NCH range in late May 1988, it became apparent that even as late as early May (1988) young Nelchina caribou had still been present on Mentasta Range.

Because we had no proof that the caribou radio-collared on the Mentasta range in late spring and then leaving for Nelchina range were Nelchina caribou, we radio-collared eight 4-month-old Mentasta female 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 during the 1988-89 winter. Four of these radiocollars were lost during the winter: two went on mortality mode, and no signal was heard from the other two after mid-February 1989. None of these were visually observed. Since these are short-term, expandable collars, these calves may have dropped the collars, as opposed to having died. The remaining four calves returned to Mentasta calving grounds by early May. Two of these were located throughout the calving period on the Mentasta calving grounds. None of these were found west of the Copper River. This limited sample showed no immigration by Mentasta short yearlings.

Since we began radio-collaring Nelchina and Mentasta caribou in 1981, we have 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 calving grounds. 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 11 months 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 do not know whether this cow was a Nelchina caribou that spent its 2-year-old year (and possibly also it yearling year) on the Mentasta range before returning to its range of origin, or if it is a Mentasta cow that emigrated at the end of its 2-year-old year. Since this cow calved, apparently for the first time, after moving to the

Nelchina range, the question arises as to what role pregnancy may have played in this change in range use?

Because this incident was the only one among 175 radio-collared Nelchina and Mentasta female caribou from 1981-1990, 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 herd interchange among young females may be higher than among adult cows.

CONCLUSIONS

This study was initiated in spring 1987 to develop a more comprehensive understanding of MCH population dynamics and to determine why the MCH has shown only slow population growth for many years. Part of our initial focus was to measure productivity by evaluating calf production and neonatal mortality. We expected to observe calving success typical of the MCH over the past 10 years (i.e., approximately 40 calves:100 cows at the end of the calving period). Instead we observed a postcalving production of 18 calves:100 cows in 1987. The subsequent years 1988 and 1989 also saw poor calf survival. As a result, this study has shown a 3-year substantial decline in population size for the Mentasta caribou herd.

Conclusions and thoughts reached after three years of study are listed here:

1. Over the past two years in the spring we examined, measured, and collected blood samples from 54 caribou. In terms of body condition, body measurements of various aged caribou, and blood chemistry parameters, no indications of poor physiological condition typically associated with range-related nutritional stress were found. All of these Mentasta caribou were rated in fair to good condition.

2. We derived birth rates for this herd in all 3 years 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 over the past three years.

3. Calving in all 3 years began and ended at approximately the same times. MCH calving peaked 28 May in 1987, 25 May in 1988 and 26 May in 1989. These median dates approximate what has been observed in the Nelchina and Delta caribou herds.

4. Neonatal calf mortality was much higher than what was observed in adjacent herds increasing in size. For all 3 years, based on the radiocollared samples, a mean of 69% of new born MCH calves were lost prior to the end of the calving period. This compares to an estimated mean loss of 18% for the Nelchina herd from 1980-83 (Pitcher, 1987). This high neonatal mortality was approximately the same for calves of radio-collared cows as it was for the herd in general. Most new calf mortality occurred during the last 3 weeks of the 4 week calving period. In 1988 and 1989, with an earlier and more concentrated level of calving, mean length of survival was 7.5 and 8.0 days respectively 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 is consistent with calves being 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 second half of the calving period; however, only a few deaths were directly linked to predation. Only by radio-collaring and intensively monitoring neonatal calves can the causes of death be thoroughly evaluated.

6. Mortality throughout the remainder of the MCH calf's first year remained high. Over the 3 years, based on the radiocollared sample, an annual mean of 75% of calves alive at the end of the calving period were lost before the next spring. For the Nelchina herd the comparable mortality rate is 46%. Such calf mortality occurred primarily during the summer, or early fall (73%). We speculate that the overwinter survival of Mentasta calves was approximately the same as for Nelchina calves, because of the presence of large numbers of wintering Nelchina caribou. Also, the wintering grounds may have had a lower wolf density than did the Mentasta calving grounds.

7. Adult mortality among radio-collared cows in the MCH was higher than in the NCH. Much of the mortality (75%) occurred during calving and subsequent summer/fall periods. Much of this mortality may result from an increased predation risk associated with calving and summering where relatively high predator-to-prey ratios exist. 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 was high enough to be a contributing factor in the MCH decline, 1987-1990. The main 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. It is estimated that the MCH has declined over the period 1987-1990 at an annual rate

of -0.91 to -0.93. This is equivalent to a herd decline of from approximately 2,900 to 2,300 caribou.

9. Seasonal changes in the range used by radio-collared cows were described.

RECOMMENDATIONS

These recommendations were formulated in 1990 at the end of the study.

1) After 3 years showing normal birth rates and high neonatal mortality, causes of such mortality should be investigated. By examining and radiocollaring newborn calves causes of neonatal mortality can be determined. With such information we will be in a better position to evaluate management procedures and select the most appropriate for the MCH.

   The MCH has declined to a population size below the current management objective of 2,500 animals. Seasons and bag limits have been reduced substantially over the past 3 years resulting in a decline in harvest to approximately 2%. There is little room for further reductions in the MCH caribou harvest (almost all bulls). Park restrictions since 1980 have reduced hunting opportunity of most game species for both the small rural communities of northern GMU 11 and the resident and non-resident sport hunter. There is strong interest in maintaining at least a minimal opportunity for hunting caribou in this area. Efforts to reduce MCH population decline should be directed at the major mortality factor(s) - the most likely being predation. Even with more information documenting high mortality from predators, NPS policy and public attitudes concerning management of predators may conflict with any program directed at active reduction of predators.

2) As discussed in the background of this report, concern has been raised by investigators over the years concerning the overlap and use by Nelchina caribou of Mentasta winter range. If range related nutritional stress is ever expressed in this area, it will most likely be associated with the caribou winter range of GMU 11 and 12. For the potential long-term benefit of not only Mentasta caribou but all the herds that utilize this area, we recommend that range studies directed at describing this winter range and its condition be initiated.

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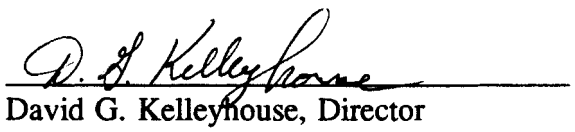

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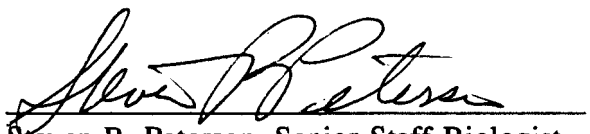

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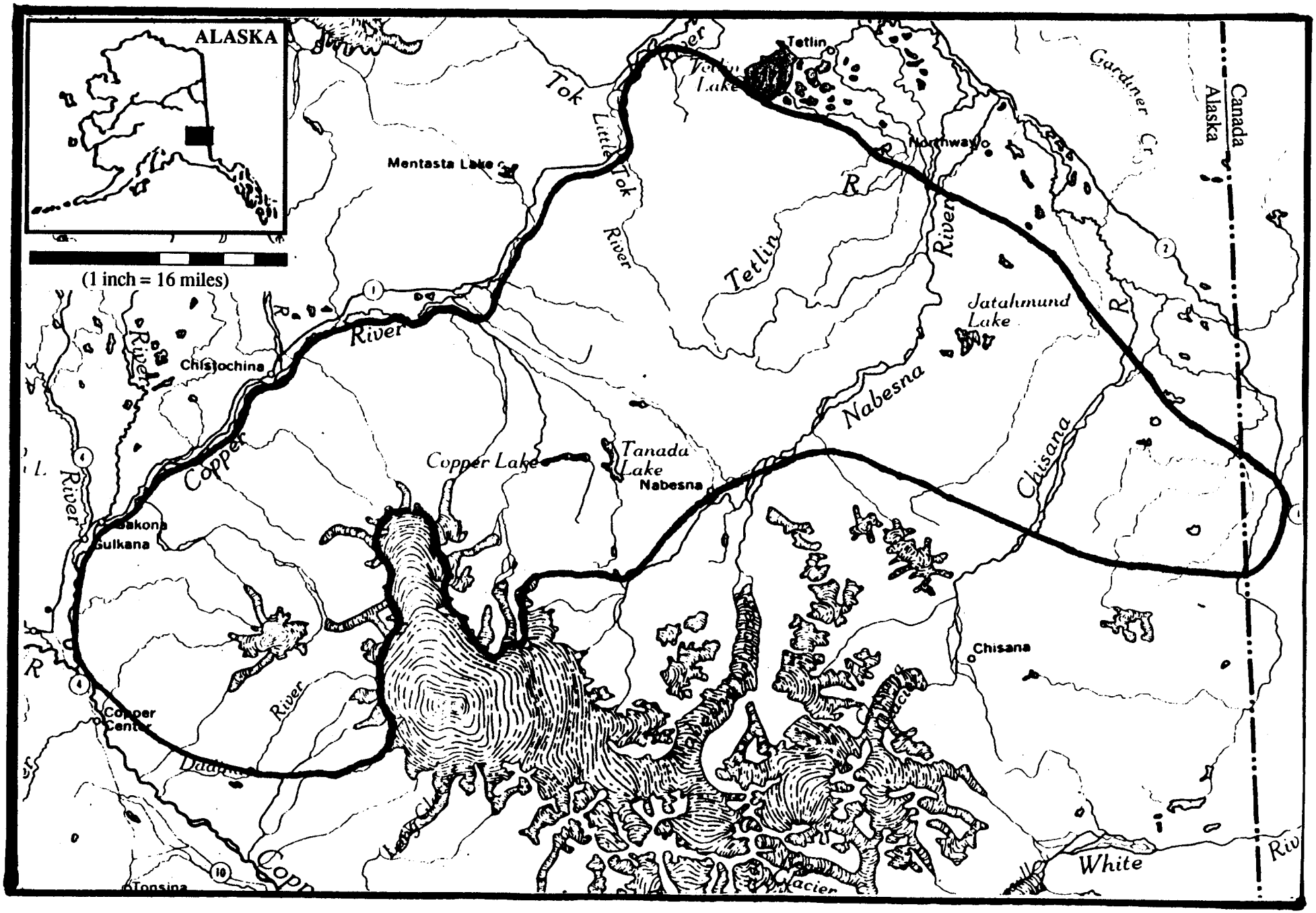

Figure 1. Mentasta caribou range.

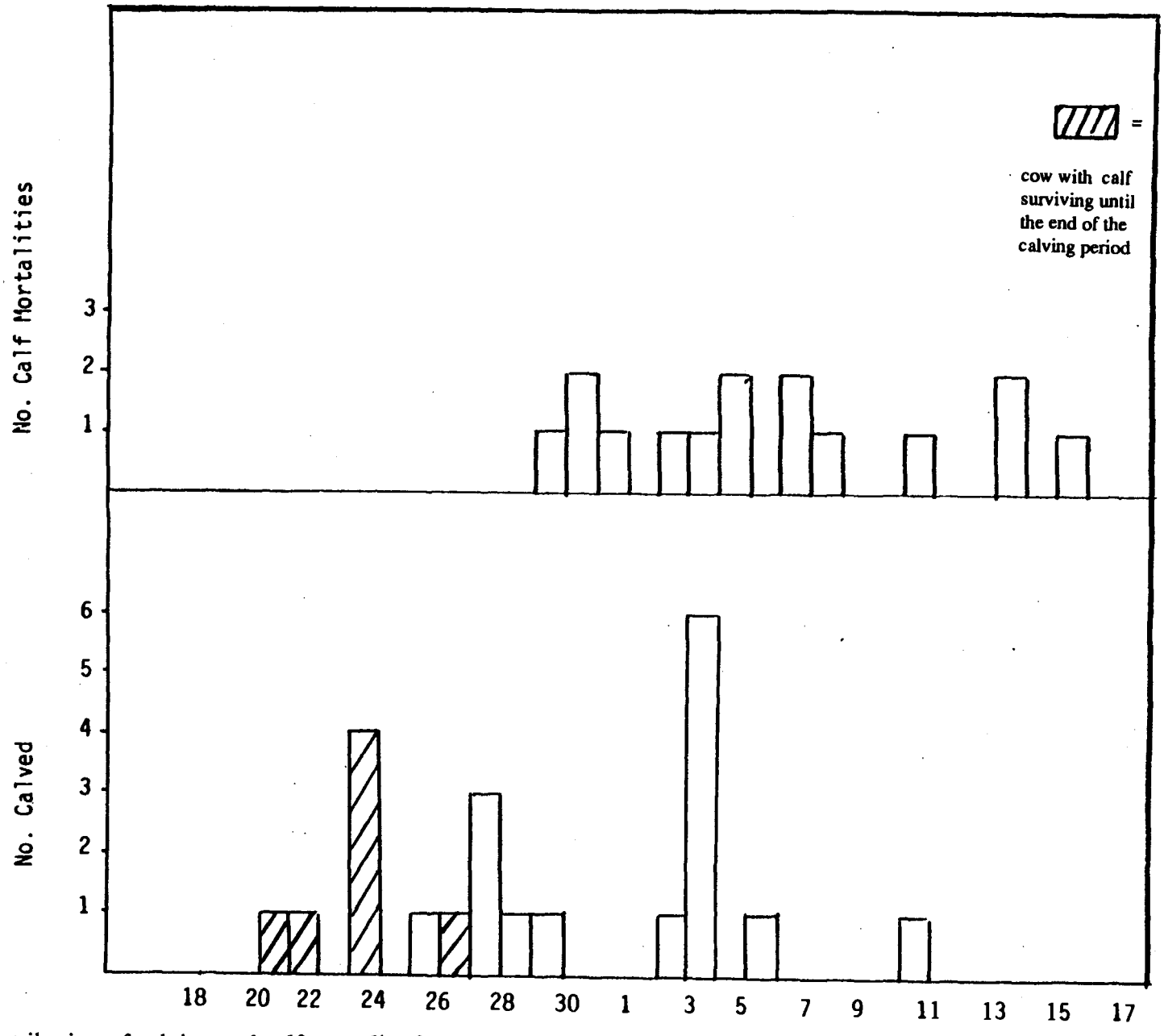

Figure 2A. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period 19 May to 16 June 1987.

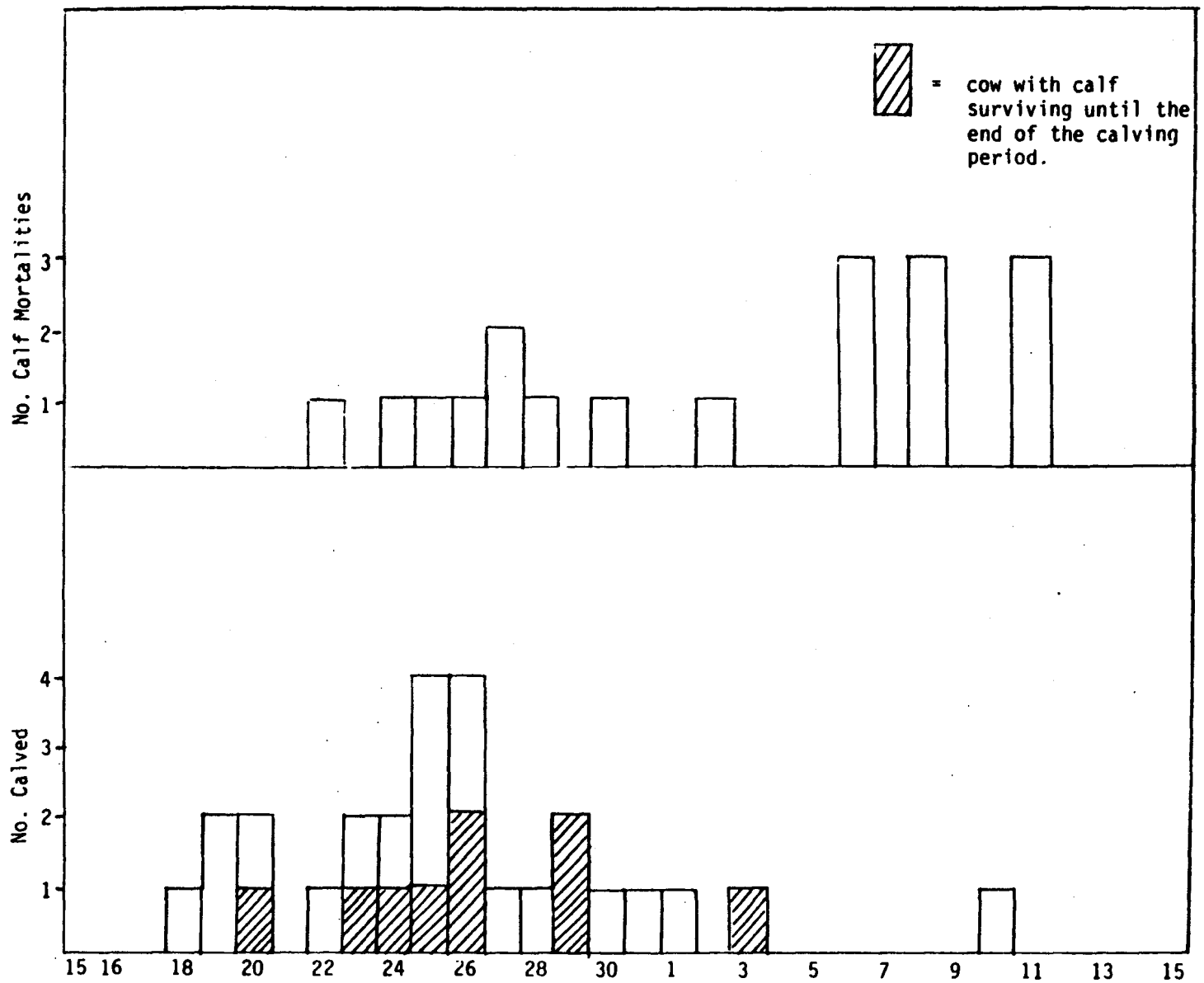

Figure 2B. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period, 17 May to 15 June 1988.

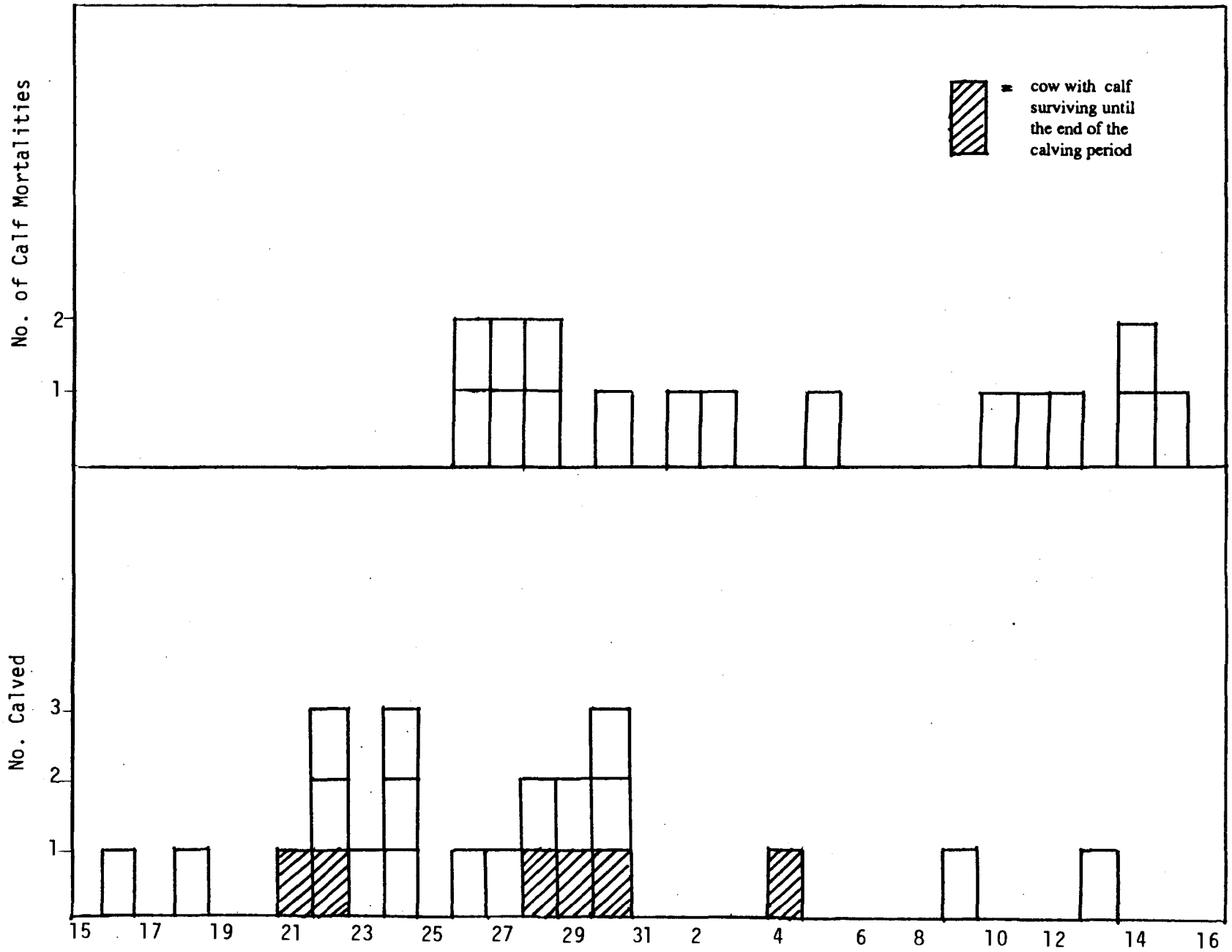

Figure 2C. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period, 16 May to 16 June 1989.

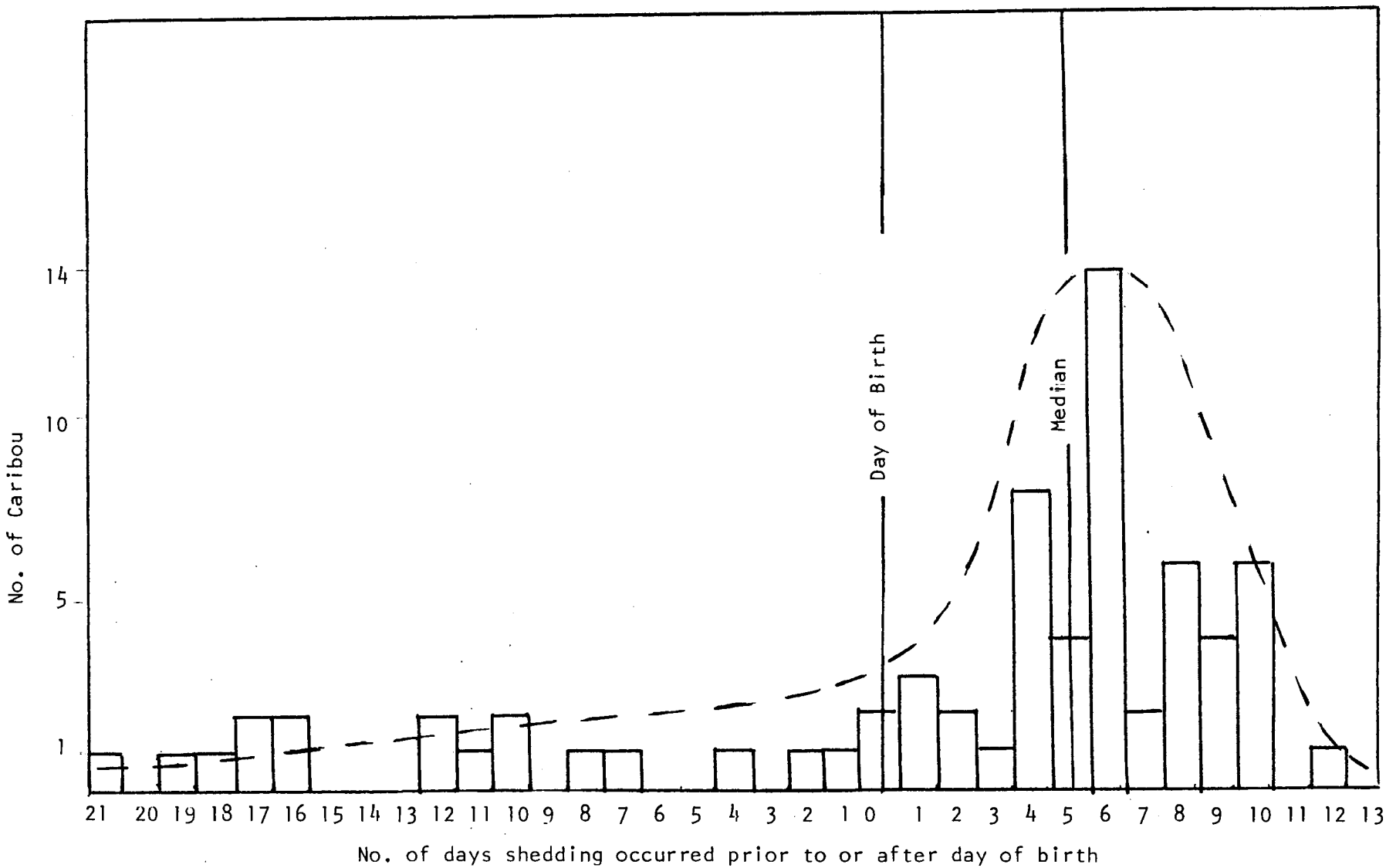

Figure 3. Antler Shedding by Calving Mentasta Caribou, 1987-89.

Table 1A. 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								
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								
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								
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								
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] Number of caribou measured in parentheses

Table 1B. 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 1C. 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 2A. Calving status of radio-collared Mentasta cow caribou by age (percentage of total cows in age class), 1987.

	Age Class, May 1, 1987[a]				
	Yearling	2 years	3+ years	No age	Total
Calf observed:	0 (1)	3 (75)	18 (75)	1 (100)	22 (67)
Antlers retained (possibly calved):	2 (50)	1 (25)	3 (13)	0 --	6 (18)
Subtotal Possibly calved:	2 (50)	4 (100)	21 (88)	1 (100)	28 (85)
Antlers not retained (considered as having not calved):	2 (50)	0 --	3 (12)	0 --	5 (15)
Total cows:	4	4	24	1	33

[a]On May 1, yearling = 1 year 11 mos., 2 years = 2 years 11 mos., etc.

Table 2B. Calving status of radio-collared Mentasta cow caribou by age (percentage of total cows in age class), 1988.

	Age Class, May 1, 1988[a]				
	Yearling	2 years	3+ years	No age	Total
Calf observed:	--	2 (40)	24 (96)	1 (100)	27 (85)
Antlers retained (possibly calved):	--	--	1 (4)	--	1 (3)
Subtotal Possibly calved:	--	2 (40)	25 (100)	1 (100)	28 (88)
Antlers not retained (considered as having not calved):	1 (100)	3 (60)	--	--	4 (13)
Total cows:	1	5	25	1	32

[a]On May 1, yearling = 1 year 11 mos., 2 years = 2 years 11 mos., etc.

Table 2C. Calving status of radio-collared Mentasta cow caribou by age (percentage of total cows in age class), 1989.

	Age Class, May 1, 1989[a]			
	Yearling	2 years	3+ years	Total
Calf observed:	0	1 (100)	21 (88)	22 (76)
Antlers retained (possibly calved):	0	--	2 (8)	2 (7)
Subtotal Possibly calved:	0	1 (100)	23 (96)	24 (83)
Antlers not retained (considered as having not calved):	4 (100)	--	1 (4)	5 (17)
Total cows:	4	1	24	29

[a]On May 1, yearling = 1 year 11 mos., 2 years = 2 years 11 mos., etc.

Table 3A. Timing of antler drop relative to calving by radio-collared Mentasta cow caribou, 1987.

No. of days between antler drop and calving	Age Class, May 1, 1987 Yearling	2 years	3+ years	No age	Total
			Cows calving		
15-21+ days prior to calving	--	--	3	--	3
8-14 days prior to calving	--	--	3	--	3
1-7 days prior to calving	--	1	2	--	3
0-6 days after calving	--	1	7	1	9
7-13 days after calving	--	1	2	--	3
Information concerning antler drop incomplete	--	--	1	--	1
Calving subtotal	0	3	18	1	22
			Cows possibly calving - dropped antlers after mid-May		
	2	1	3	0	6
			Cows probably not calving - dropped antlers prior to mid-May		
	2	0	3	0	5
Total	4	4	24	1	33

Table 3B. Timing of antler drop relative to calving by radio-collared Mentasta cow caribou,1988.

No. of days between antler drop and calving	Age Class, May 1, 1988				
	Yearling	2 years	3+ years	No age	Total
			Cows calving		
15-21+ days prior to calving	--	--	2	--	2
8-14 days prior to calving	--	--	3	--	3
1-7 days prior to calving	--	--	--	--	0
0-6 days after calving	--	1	7	1	9
7-13 days after calving	--	1	12	--	13
Calving subtotal	0	2	24	1	27
			Cows possibly calving - dropped antlers after mid-May		
	--	--	1	--	1
			Cows probably not calving - dropped antlers prior to mid-May		
	1	3	--	--	4
Total	1	5	25	1	32

Table 3C. Timing of antler drop relative to calving by radio-collared Mentasta cow caribou, 1989.

No. of days between antler drop and calving	Age Class, May 1, 1989				
	Yearling	2 years	3+ years	No age	Total
	Cows calving				
15-21+ days prior to calving	--	--	2	--	2
8-14 days prior to calving	--	--	--	--	0
1-7 days prior to calving	--	--	1	--	1
0-6 days after calving	--	1[a]	14	--	15
7-13 days after calving	--	--	4	--	4
Calving subtotal	0	1	21	--	22
	Cows possibly calving - dropped antlers after mid-May				
	--	--	2	--	2
	Cows probably not calving - dropped antlers prior to mid-May				
	4	--	1	--	5
Total	4	1	24		29

[a]Retained 1 antler from at least 5/16 to 5/30.

Table 4A. Results of a helicopter survey of Mentasta cow caribou with and without calves and distended udders on 30 May 1987.

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

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

	Cows Observed	Percent of total Sample
No. cows with calves:	184	30
No. of cows without calves but with distended udders:	248	41
Parturient Cow Subtotal:	432	71
No. of cows without calves and without distended udders:	179	29
Total Sample:	611	100

Table 4C. Results of a helicopter survey of Mentasta cow caribou with and without calves and distended udders on 31 May 1989.

	Cows Observed	Percent of total Sample
No. cows with calves:	90	30
No. of cows without calves but with distended udders:	115	39
Parturient Cow Subtotal:	205	69
No. of cows without calves and without distended udders:	93	31
Total Sample:	298	100

Table 5A. Summary of the status of 22 calves born to radio-collared Mentasta caribou, 1987.

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

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

Table 5B. Summary of status of 27 calves born to radio-collared Mentasta caribou, 1988.

Date	Cumulative Number of calves born	Cumulative Number of 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[a]	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 5C. Summary of status of 22 calves born to radio-collared Mentasta caribou, 1989.

Date	Cumulative Number of calves born	Cumulative Number of calves alive	Calves alive as a percent of calves born	Calves: 100 cows	No. of collared cows
05/23/89	7	7	100	24	29
05/31/89	19	12	63	41	29
06/08/89	20	10	50	34	29
06/16/89	22	6	27	21	29
08/03/89	22	1	5	4	28
09/22/89	21[a]	0[a]	0	0	24
11/27/89	--	-	--	--	24
01/18/90	--	-	--	--	24
04/06/90	--	-	--	--	23

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

Table 6A. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period 19 May-16 June, 1987.

Week of calving period	No. of calves born	No. of calves dying	No of calves born per week that died by June 16		Mean age at death of calves dying by June 16 (in days)	
			No.	Percent of total calves for that week	Mean	Range
May 19-26	8	1	1	(13)	8.0	(--)
May 27-June 2	6	3	6	(100)	4.5	(1-11)
June 3-9	7	7	7	(100)	4.1	(1-12)
June 10-16	1	4	1	(100)	3.0	(--)
Total	22	15	15	(68)	4.5	(1-12)

Table 6B. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period 17 May - 15 June 1988.

Week of calving period	No. of calves born	No. of calves dying	No of calves born per week that died by June 16 Percent of total calves for No. that week		Mean age at death of calves dying by June 15 (in days) Mean	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	(--)
	27	18	18	(67)	7.5	(1-19)

Table 6C. Distribution of calving and calf mortality for radio-collared Mentasta caribou during the calving period 16 May -16 June, 1989.

Week of calving period	No. of calves born	No. of calves dying	No of calves born per week that died by June 16 Percent of total calves for		Mean age at death of calves dying by June 16 (in days)	
			No.	that week	Mean	Range
May 16-23	7	0	5	(71)	11.4	(4-22)
May 24-31	12	7	9	(75)	7.4	(0-21)
June 1-8	1	3	0	---	---	
June 9-16	2	6	2	(100)	2.0	(--)
Total	22	16	16	(73)	8.0	(0-22)

Table 7A. Mortality of radio-collared Mentasta cow caribou, May 1987 - April 1988.

	No. of radio-collared cows	Percent of total
Total no. radio-collared cows 4/10/87	35	
Radio-collaring losses	2	
Total, 4/30/87	33	(100)
Died during calving	2	
Died during summer/fall	1	
Died during winter	1	
Total mortality 1987-88	4	(12)
Total no. radio-collared cows 4/30/88	29	

Table 7B. Mortality of radio-collared Mentasta cow caribou, May 1988-April 1989.

	No. of radio-collared cows	Percent of total
Total no. radio-collared cows 4/30/88	29	
Emigration of radio-collared cow 5/04/88	-1	
Additional cows radio-collared 5/05/88	4	
Total 5/05/88	32	(100)
Died during calving	1	
Died during summer/fall	2	
Died during winter	1	
Total mortality 1988-89	4	(13)
Radio-collars ceasing to function 1988/1989	2	
Total no. radio-collared cows 4/30/89	26	

Table 7C. Mortality of radio-collared Mentasta cow caribou, May 1989-April 1990.

	No. of radio-collared cows	Percent of total
Total no. radio-collared cows 4/30/89	26	(100)
Radio-collared as short yearlings in spring 1988	4	
Total 5/01/89	30	
Died prior to calving	1	
Died during calving	0	
Died during summer/fall	2	
Died during winter	1	
Total mortality 1989-90	5	(17)
Radio collar ceasing to function 1989-90	2	
Total no. radio-collared cows alive, 4/06/90	23	

Table 7D. Mortality of radio-collared Mentasta yearling and two-year-old caribou, 1987-1990.*

	Number of Mortalities/Number of Cows			
	1987/88	1988/89	1989/90	Total
Yearlings	0/4	0/1	1/4	1/9
2-year olds	0/4	0/5	0/1	0/10
Yearling and two-year olds combined	0/8	0/6	1/5	1/19

* yearling = 1 year 11 mos on May 1 of year
2 year old = 2 years 11 mos on May 1 of year

Table 8. Hunter harvest, Mentasta caribou herd, 1972-1989.

Year	Reported Harvest	Percent bulls	No. permits issued	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
1989[c]	45	93	158	28

[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 for nonlocal residents.

Table 9. Population and composition estimates, Mentasta Caribou herd, 1962-1989.

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
1989	2,602	2,687	31	16	10	45	28

[a]Winter count

Table 10a. 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, 1986	April 1, 1987	May 15, 1987	July 1, 1987	Oct. 1, 1987	April 1, 1988
725 bulls	711 bulls	881 bulls	864 bulls	760 bulls	742 bulls
(39:100 cows)				(41:100 cows)	
1,875 cows	1,855 cows	2,013 cows	1,932 cows	1,853 cows	1,812 cows
459 calves	352 calves		348 calves	222 calves	109 calves
(25:100 cows)	(19:100)		(18:100 cows)	(12:100 cows)	(6:100cows)
3,059 caribou	2,918 caribou	2,894 caribou	3,144 caribou	2,835 caribou	2,663 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 annual mortality	Annual mortality rate
6 bulls (1%)	17 bulls (2%)	13 bulls (1.1%)	91 bulls (10%)	18 bulls (2%)	145 bulls	(16%)
18 cows cows (1%)	81 cows (4%)	58 cows (3%)	21 cows (1%)	41 cows (2%)	219 cows	(11%)
-- calves	-- calves	126 calves (36%)	0 calves	113 calves (33%)	239 calves	(69%)
24 caribou	98 caribou	197 caribou	112 caribou	172 caribou	603 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 composition 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 over wintering calves (short-yearlings) are assumed to have a 50:50 male:female ratio, and included with bulls and cows in the estimated pre-calving population.

[3]Calf-of-the-year mortality prior to July 1 is not included in this model.

[4]Mortality rate in parenthesis is percentage of the total number of bulls (887) and cows (2,031) in the estimated population as of April 1, 1987, and the total number of calves (348) as of July 1, 1987.

Table 10b. Model of population changes and mortality in the Mentasta Caribou Herd, April 1988 - April 1989.

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
760 bulls	742 bulls	788 bulls	781 bulls	716 bulls	700 bulls
(41:100 cows)				(43:100 cows)	
1,853 cows	1,812 cows	1,829 cows	1,754 cows	1,684 cows	1,646 cows
222 calves	109 calves		596 calves	307 calves	135 calves
(12:100 cows)	(6:100)		(34:100 cows)	(18:100 cows)	(8:100 cows)
2,835 caribou	2,663 caribou	2,617 caribou	3,131 caribou	2,707 caribou	2,481 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 annual mortality	Annual mortality rate
8 bulls (1%)	7 bulls (1%)	3 bulls (0.5%)	65 bulls (8%)	13 bulls (2%)	96 bulls	(12%)
38 cows (2%)	75 cows (4%)	66 cows (4%)	4 cows (0%)	38 cows (2%)	221 cows	(12%)
-- calves	-- calves	289 calves (36%)	0 calves	172 calves (28%)	461 calves	(77%)
46 caribou	82 caribou	358 caribou	69 caribou	223 caribou	778 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 composition 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 1988 relative to the same in 1987.

[2]1987-88 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 population.

[3]Calf-of-the-year mortality prior to July 1 is not included in this model.

[4]Mortality rate in parenthesis is percentage of the total number of bulls (796) and cows (1,867) in the estimated population as of April 1, 1988, and the total number of calves (596) as of July 1, 1988.

Table 10C. Model of population changes and mortality in the Mentasta Caribou Herd, April 1989-April 1990.

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, 1988	April 1, 1989	May 15, 1989	July 1, 1989	Oct. 1, 1989	April 1, 1990
716 bulls	700 bulls	756 bulls	756 bulls	690 bulls	675 bulls
(43:100 cows)				(45:100 cows)	
1,684 cows	1,646 cows	1,696 cows	1,656 cows	1,541 cows	1,506 cows
307 calves	135 calves		515 calves	255 calves	125 calves
(18:100 cows)	(8:100)		(31:100 cows)	(16:100 cows)	(8:100 cows)
2,707 caribou	2,481 caribou	2,455 caribou	2,927 caribou	2,476 caribou	2,306 caribou

Associated Annual Cycle of Estimated Mortality[4]

Spring 89 mortality	89 Calving period mortality	Summer/early fall 89 mortality	89 hunt mortality	Winter 89/90 mortality	Total annual mortality	Annual mortality rate
8 bulls (1%)	3 bulls (0.5%)	6 bulls (1%)	60 bulls (8%)	15 bulls (2%)	92 bulls	(12%)
18 cows (1%)	40 cows (2%)	113 cows (6%)	2 cows (--%)	35 cows (2%)	208 cows	(12%)
-- calves	-- calves	270 calves (51%)	0 calves	120 calves (25%)	390 calves	(76%)
26 caribou	43 caribou	389 caribou	62 caribou	170 caribou	690 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 composition 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 1990 relative to the same in 1989.

[2]1988-89 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 population.

[3]Calf-of-the-year mortality prior to July 1 is not included in this model.

[4]Mortality rate in parenthesis is percentage of the total number of bulls (767) and cows (1,714) in the estimated population as of April 1, 1989, and the total number of calves (515) as of July 1, 1989.

Appendix A. Capture of Mentasta Caribou by Carfentanil, April 1987.

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, IA) 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) 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. Both had injuries incurred while attempting to cross a boulder field, one was wedged between rocks with its legs entrapped.

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 immobilized 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. 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 Alaska Peninsula 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 D. 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 8 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 E. Field information for Mentasta cow 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	2	0	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 F. 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 G. Calving and calf mortality dates for the radio-collared Mentasta cow caribou, 1987.

Cow No.	Estimated calving date	Estimated date calf lost	Calf alive at end of calving period 6/16/87
4	6/03	6/07	
9	5/27	5/31	
10	6/03	6/06	
11	5/23	6/28	X
13	5/27	5/29	
15	6/02	6/13	
18	6/10	6/13	
19	5/26	7/25	X
21	5/20	---	X
23	5/23	---	X
24	5.23	1/20	X
25	5/25	6/02	
28	6/03	6/10	
32	5/21	6/28	X
33	6/05	6/06	
Y34	5/27	6/03	
Y37	5/23	---	X
Y57	6/03	6/04	
N39	5/29	5/30	
N40	5/28	5/30	
N42	6/03	6/15	
N43	6/03	6/04	

Appendix H. Calving and calf mortality dates for radio-collared Mentasta cow caribou, 1988.

Cow No.	Estimated calving date	Estimated date calf lost	Calf alive at 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

Appendix I. Calving and calf mortality dates for radio-collared Mentasta cow caribou, 1989.

Cow No.	Estimated calving date	Estimated date calf lost	Calf alive at end of calving period 6/16/89
1	5/22	5/26	
2	5/24	6/14	
3	5/26	5/28	
4	5/21	----	X
6	6/04	----	X
10	5/29	6/12	
12	5/29	----	X
13	5/22	----	X
15	5/24	5/26	
18	5/30	6/05	
19	5/30	6/01	
21	5/27	6/10	
25	5/24	5/30	
27	5/18	6/02	
32	5/22	5/27	
33	5/23	6/14	
37	5/28	----	X
40	5/28	5/28	
44	6/13	6/15	
Y34	5/30	----	X
N42	5/16	5/27	
N43	6/09	6/11	