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SEWARD PENINSULA MOOSE POPULATION IDENTITY STUDY

By

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SUMMARY

In April 1981, 40 adult moose (22 cows, 18 bulls) were instrumented with radio collars on 2 drainages in the central Seward Peninsula (Game Management Unit 22D). Thirty-four moose were immobilized from helicopters and 6 from the ground, using snowmachines. Snowmachines proved effective as a means of capture in open terrain or when willow stands were less than 50 m in width. In April 1982, 9 bulls and 1 cow were instrumented to replace radios that failed or to replace radios from moose that died. Body measurements suggested that Seward Peninsula moose are larger than comparable animals from other Alaska populations, but they are not the largest in the state. Ages of radio-collared moose were similar to ages of moose from hunter-killed samples.

Blood samples were collected annually every April from 1981-84 and analyzed for hematological and serological values described by Franzmann et al. (1976). Packed cell volume (PCV), hemoglobin (Hb), total serum protein (TSP), calcium (Ca), and phosphorus (P) were compared between years and with 17 other populations of Alaskan moose. Blood samples from 1981 indicated moose were in average condition; subsequent samples indicated moose experienced a decline in physical condition. Analysis of 15 trace elements from hair collected in 1981 was inconclusive, but levels of some elements were below normal, compared to other moose populations. Serological tests for 9 diseases showed moose were relatively disease free.

Seasonal movements of moose fell into 3 general catagories: (1) sedentary, moose moving less than 24 km from point of capture; (2) highly migratory, moose moving farther than 32 km; and (3) intermediate, moose whose movements were between 24-32 km.

Unit 22 moose are highly migratory compared to most other Alaskan moose populations. Increasing snow depth was probably the most important factor in stimulating moose to move from summer range to winter range. When snowcover was light, some moose remained on summer range the year round. Distances between winter and summer range varied from 6 to 80 km (4-50 mi). Seasonal fidelity to the same winter range was high; 29 of 32 moose returned to the winter range of capture. Several moose used alternate winter and summer ranges during the study. Home ranges of radio-collared moose varied in size from 91 km^2 to 1,931 km^2 (35-746 mi^2). Composite home range of 18 radio-collared moose in the Agiapuk drainage was 6,019 km^2 (2,324 mi^2) and composite home range of 19 moose in the Kuzitrin drainage was 6,000 km^2 (2,317 mi^2). Overlap area of the 2 composite home ranges was 13%.

Most calf mortality occurred during the summer. Calves had a high probability of living to 1 year of age if they survived until November. Calf survival of radio-collared moose in May/June 1981 was initially 118 calves:100 cows, but the ratio declined to 70 calves:100 cows in 1983. A decline in calf productivity/survival in Subunit 22D was also verified by an analysis of composition counts from 1971-83. Annual mortality of radio-collared moose was 14.5%; bulls experienced the highest mortality, 21% annually, all by hunters. Movement, home range, and mortality data strongly support managing moose in the Kuzitrin and Agiapuk drainages as 1 population.

Key words: *Alces alces*, blood serology, calf survival, home range, management, moose, mortality, movements, population identity, Seward Peninsula.

CONTENTS

BACKGROUND

Moose (Alces alces) were virtually absent from the Seward Peninsula (Game Management Unit 22) 30 years ago. An aerial survey conducted by the Department in spring 1960 revealed only 13 moose, all in the eastern portion of the peninsula. Aerial surveys in subsequent years documented a rapid increase in moose in the late 1960's and their expansion into all areas containing winter habitat. By the mid-1970's population growth rate declined, and numbers stabilized in some areas. Unit 22 now supports a moose population in excess of 2,500 animals (Grauvogel 1981). Winter browse is limited primarily to narrow stands of willow (Salix spp.) along major drainages. Density of moose on the winter range is high, especially in the central portion of the Seward Peninsula (Subunits 22B and 22D). These areas also supported an exceptionally dense population of snowshoe hares (Lepus americanus) from 1978 through winter 1980. High hare and moose densities may have adversely affected the quality and/or quantity of the winter range because of overbrowsing. Range factors in Unit 22 are at present poorly understood. However, aerial surveys in the spring have shown that the percentage of short yearlings (calves 10 months old) has declined from a high of 30% in the early 1970's to a recent 5-year average of 19%. This decline may have several causes, but I believe 1 contributing factor is increased competition as moose numbers approach range carrying capacity. To effectively manage the population and achieve the desired density of moose for existing range conditions, information is needed on the fidelity of moose to their wintering range, the size of annual home ranges, timing of seasonal movements, the extent of migration or immigration into new areas, reproductive history and calf mortality, and a determination of the nutritional status of the moose population during late winter.

Average annual harvests have increased from 56 moose in the late 1960's to 309 animals during the most recent 5-year period (405 killed in 1983-84). Nearly 1/2 of the harvest was reported from Subunit 22D, an area traversed by a gravel road which provides easy access from Nome. Demand for moose by recreational and subsistence hunters living within Unit 22 is high, and the number of nonlocal hunters has steadily increased. Furthermore, mineral exploration has intensified in the area during the last 5 years, and major developments are likely to occur in the near future. Information on population identities and magnitude of seasonal movements is necessary to manage the resource for optimum sustained harvests, to effectively allocate harvest among user groups, and to avoid or mitigate problems associated with mineral development.

OBJECTIVES

To determine population identities and seasonal movement patterns of moose on the central Seward Peninsula.

STUDY AREA

Two drainages within Subunit 22D were selected for the moose radio-collaring work. The Kuzitrin drainage encompasses all of the eastern portion of Subunit 22D, and the Agiapuk drainage is located near the western edge of the subunit (Fig. 1). These 2 rivers form a drainage basin of approximately 12,395 km^2 (4,800 mi^2) ranging in elevation from sea level to 1,541 m (4,700 ft). The basin is bounded on the south and east by 2 geologically young mountain ranges, the Kigluaik and Bendeleben Mountains. Each range contains precipitous slopes, numerous rocky outcrops, and relatively sparse vegetation, except at low elevations. The mountains on the northern side of the basin are lower in elevation (maximum height 941 m [2,870 ft]), and the relief is predominantly rolling hills with gentle slopes. Both rivers terminate in Imuruk Basin, a lake whose waters flow into the Bering Sea 56 km (35 mi) to the west.

The vegetation of the region is primarily wet tundra at lower elevations, but it usually grades into dry tundra as the land slopes upward and has higher relief. Willows commonly grow along all rivers and into the headwaters of all tributaries. Along the lower portions of the major rivers, willows attain heights of 3-4.5 m (10-15 ft), and the stands extend as far as 400 m from either side of the main water course. Willows generally become less abundant upstream. Willows growing in the upper tributaries and alpine areas average 1-3 m in height, and growth is typically limited to a few meters on either side of streams. However, extensive stands of "shrub" willows occur on hillsides where sufficient moisture is present.

The absence of trees is a striking characteristic of the region. Spruce (*Picea* spp.) is found only in a few scattered locations in the extreme eastern portion of the Subunit. Aspen (*Populus tremuloides*) is present only in a few isolated stands along the major rivers. The lack of trees and the predominant tundra vegetation result in extensive open habitat.

METHODS

Radio-collaring moose in 2 drainages provided a means to compare results from 2 areas within Subunit 22D. Forty adult moose (18 bulls and 22 cows) were captured on the Kuzitrin and Agiapuk drainages and fitted with visual and radio collars during the period 14-16 April 1981. Collars were placed on 10 bulls and 10 cows in the Kuzitrin drainage and 8 bulls and 12 cows in the Agiapuk drainage. Biologists immobilized 34 moose using standard helicopter darting techniques (Gasaway 1977) with fixed-wing aircraft flying support cover. Six animals were captured from the ground.

The feasibility of capturing moose using ground transportation was tested by using snowmachines in conjunction with fixed-wing aircraft. Three snowmachines were used, each with 2 riders, an operator and a gunner. The operator carried a hand-held radio to provide communication with an aircraft above. An aircraft pilot accompanied by a radio operator located moose and relayed instructions to ground crews to coordinate their movements in relation to targeted moose.

Ten moose (9 bulls, 1 cow) were collared 27 April 1982 to replace radio collars that were lost during the year from equipment malfunctions, moose that died, or from moose that slipped their collars. In April 1983 and 1984, 10 and 9 radio-collared moose, respectively, were immobilized again to collect blood samples and determine each animal's physical condition.

Moose were immobilized with a mixture of 8 cc of M99 (etorphine hydrochloride, 1 mg/cc) and 2 cc of Rompun (xylazine hydrochloride, 100 mg/cc) delivered in 10 cc tubular darts fired with a Palmer Cap-Chur gun. If moose required additional doses for complete immobilization, 3 cc of M99 were delivered in a 3 cc dart. Of the 40 moose captured in 1981, 14 required a 2nd dose and 1 required a 3rd dose. Additional doses were required when the 1st dart failed to function properly or struck a part of the body where the drug was not readily absorbed into the circulatory system.

From April 1981-84, no moose died as a result of capture or marking by either the helicopter or snowmachine crews. One adult bull captured by the snowmachine crew laid down after moving 100 m following injection of the antagonist (M50-50). This animal had been chased for 27 minutes before it was completely immobilized and was probably physiologically very stressed. However, it recovered with no apparent ill effects.

Each immobilized moose was processed in a similar manner, and data were recorded on field cards 5 x 8 inches. Body measurements included total length, hind foot length, and heart girth. Overall body condition was assessed on a 1-10 scale according to criteria developed by Franzmann et al. (1976). The I-1 incisor was extracted, and its age was determined using the method employed by Sergeant and Pimlott (1959). Up to 40 ml of blood were collected from the jugular vein in sterile evacuated containers to determine hemoglobin (Hb) packed cell volume (PCV), and blood chemistry as outlined by Franzmann et al. (1976). A tuft of hair was plucked from the right or left shoulder for analysis of trace elements (Franzmann et al. 1975).

Visual collars were manufactured by Denver Tent and Awning, Boulder, Colo., and constructed to specifications similar to those described by Franzmann and Arneson (1974). Each collar displayed 3 identical sets of black numbers 14 cm high on a yellow background. Numbers were situated to allow viewing from either side or from above when the collar was in place. Radio collars were manufactured by Telonics Inc., Mesa, Ariz., and operated on discrete frequencies from 151.021 to 151.921 MHz. When activated, radio collars emitted approximately 1.2 pulses/sec and were equipped with a mortality sensor causing the pulse rate to double if movement ceased for 11 hours. Visual and radio collars were placed on each moose without attachment between collars. Collars remained in place because they were usually snug when slipped over the head, and the ears (or antlers) prevented them from coming off.

Instrumented moose were located approximately once a month using fixed-wing aircraft. Depending on weather, staff support, and aircraft availability, 1 of 3 types of aircraft was used: Piper PA-12, Cessna 206, or Cessna 185. When an instrumented animal was located, its position was plotted on U.S. Geological Survey maps having a scale of 1 inch to the mile (1:63,360). Group size and composition, activity (lying or standing), vegetation type (alpine willow, lowland willow, or tundra), and any unusual conditions were recorded on a separate data sheet. Upon returning from the field, the location of each moose was plotted on an individual map (scale 1:63,360). Data points were sequentially connected with straight lines, providing a pictorial history of the movements of each moose.

RESULTS AND DISCUSSION

Capture Methods

Snowmachines proved to be a successful means of capturing moose if proper terrain was selected. Willow density and width of stands greatly influenced the efficiency of ground crews. When willow stands were too dense to allow passage of a snowmachine or exceeded 200 m in width, ground crews had difficulty flushing moose into the open. Moose were often reluctant to leave the sanctuary of dense willow stands or were able to escape to other stands before snowmachiners could get within effective shooting distance.

The crews were most effective when willows along the rivers grew in alternating clumps and/or discontinuous ribbons less than 50 m in width. Narrow, discontinous willow stands increased sightability of moose, improved coordination of movements between ground crews, and provided access for snowmachine crews to keep moose away from escape routes.

Efficiency of snowmachine crews was greatly enhanced by maintaining 2-way radio communication with a spotter aircraft above. However, crews had to stop and turn off their snowmachines before receiving instructions. Ideally, the snowmachine driver should have the radio receiver connected to an external earphone so the aircraft spotter can relay instructions while the snowmachine is in pursuit.

Once a moose was herded into the open, the snowmachine could easily overtake the animal while carrying both occupants. In 6 of 6 attempts on the Kougarok River, a tributary of the Kuzitrin River (Fig. 1), the gunner shot an immobilizing dart within 1-5 minutes from the onset of the chase. However, when traveling over the bumpy tundra at speeds exceeding 45 km per hour, the gunner had difficulty holding on with 1 arm while sighting the rifle with the other. Accuracy would have been improved had the gunner used a seat belt and/or hand gun.

Poor dart placement extended time to immobilization up to 27 minutes (3 moose needed 2 or more injections). Conversely, 3 moose struck in the large muscles of the hindquarters were all immobilized within 10-12 minutes. Three snowmachine crews working together captured and processed 6 moose in 7 hours, excluding travel time to and from the work site. In similar terrain on the same day, an experienced helicopter crew processed 10 moose during a 5-hour period. If terrain and moose density are favorable, a snowmachine accompanied by a spotter aircraft may be a viable transportation option for immobilizing moose, especially if operating funds are limited.

Body Condition, Size and Age Structure

Franzmann et al. (1976) classified the body condition of Alaskan moose on a scale from 1 to 10 with class 10 representing best condition (Table 1). Among 30 animals so classified on the Seward Peninsula in 1981, body condition ranged from a low of 5 to a high of 8. The percentages in each class were as follows: class 5, 20%; class 6, 53%; class 7, 24%; and class 8, 3%. Although most moose were judged to be below average in body condition, Franzmann (pers. commun.) indicated this condition was not unusual for moose in late winter. He participated in this capture work in 1981, and believed these moose showed no physical symptoms of malnutrition or abnormal physiological stress. Considering the relatively high density of animals on the winter range, moose generally appeared to be in good condition.

Moose that were recaptured in April 1982, 1983, and 1984 (29 total) were all judged to be in condition class 6 or 7, and in general their condition appeared to be similar to previous years. When examined closely, however, one difference was striking. The dart wound from the previous year was evident: a hairless, slate-gray patch of skin 4-7 cm in diameter at the injection site, crusty in places, with small scabs. It appeared that the dart wound had become infected and then partially healed. Frostbite probably impeded healing because of the lack of protective hair. As a precautionary measure to reduce infection, an antibiotic should be given immediately after removing the immobilizing dart.

Body measurements were obtained from 23 cows and 27 bulls (Tables 2 and 3). Mean measurements for total length, chest girth, and hind foot length were compared with mean measurements of moose from other populations throughout the state (Table 4). Data from other moose populations are predominantly from cows aged 3 and older. The largest mean body measurements were from moose populations sampled in GMU 6 (Copper River Delta) and GMU 9 (Alaska Peninsula). Mean chest girth of Unit 22 cows (200 cm) was nearly identical to mean chest girth from Units 6 and 9, (201 cm and 201 cm, respectively), but Unit 22 cows had a smaller total body length ranking 4th overall (291 cm vs 302 cm). Mean hind foot length of Unit 22 moose was 6 cm greater than the mean from any other sampled populations (88 cm vs 82 cm). (This difference may be due to inconsistent measurement standards.) Mean total length of Unit 22 bulls was 296 cm, ranking 3rd overall. However, mean chest girth (200 cm) was comparable to measurements taken from populations of large moose. Mean total length for Seward Peninsula moose was probably biased downward because 12 bulls in the sample were 3 years of age or younger. Gasaway (1975) compared antler growth by age class for several populations of Alaskan moose and found that antler growth from Unit 22 moose ranked 2nd or 3rd in the state. Available data indicate that Unit 22 moose are larger than average compared to other moose populations in the state. More data on older bulls are needed to form an accurate comparison.

Ages of 46 collared moose captured in 1981 and 1982 were determined by examining sectioned incisor teeth. Moose were assigned to each of 8 age classes, and a comparison was made with ages of moose taken by hunters from 1973 to 1983 (Table 5). Ages of harvested moose revealed a relatively young population. From 1973 to 1983, 42% of the hunter kill was composed of 2- and 3-year-old moose (27% and 15%, respectively), and only 4% of the sample was over 8 years old. In contrast, the sample of radio-collared moose indicated an older population: 2- and 3-year-old moose comprised 35% of the sample, and 30% were at least 8 years old. However, both samples were biased, and comparison should be made cautiously. The hunter-killed sample favored young animals due to hunter selectivity and nonrandom distribution of age classes during the hunting season. The radio-collared sample favored older animals because 1-year-old moose were excluded. No attempt was made to collar short yearlings (10-month-old moose). Excluding calves and yearlings, I believe the age structure of collared moose was similar to the age structure of the Unit 22 population, but probably somewhat biased toward older animals. Movement, mortality, serology, and other data obtained from radio-collared moose were probably representative of the population as a whole, although sample sizes were inadequate for precise estimation of some parameters.

Blood Parameters

Many investigators have used chemical analyses of blood to assess the physiological condition of animal populations (Rosen and Bischoff 1952; Kitts et al. 1956; McEwan 1968; Anderson et al. 1970; Franzmann 1971, 1972; LeResche et al. 1974; Pedersen and Pedersen 1975; Seal 1977; Bahnak et al. 1979; Franzmann et al. 1980). Franzmann et al. (1976) applied the technique to moose, and established baseline values for comparing Alaskan moose populations using hematological and serological criteria. Franzmann and Schwartz (1983) summarized the results of serological work on moose in Alaska from 1969 through 1981. Samples of moose blood from the Seward Peninsula were included in this study and were ranked with other Alaskan moose populations for comparison. However, values for individual moose and a discussion of the Seward Peninsula moose population were not included.

Samples from Unit 22 moose were analyzed for up to 23 different parameters; however, Franzmann and Schwartz (1983) found that packed cell volume (PCV), hemoglobin (Hb), total serum protein (TSP), calcium (Ca), and phosphorus (P) were the best 5 indicators of relative physical condition in moose populations. These parameters are less subject to variability from the stress and excitement of capture and have been shown to be consistent indicators of population condition when samples are taken in late winter/early spring. The 5 blood values obtained from each moose captured in Unit 22 are listed in Table 6. Franzmann and Schwartz (1983) reported PCV, Hb, TSP, Ca, and P values from 18 "populations" of Alaskan moose. Some samples were taken from the same moose population, but in different years (Table 7). They ranked these populations numerically in each of the 5 groups according to blood parameter values (Table 8). Three populations were used as "baseline" indicators of condition: (1) the Copper River Delta moose population represented an expanding, highly productive population; (2) the Moose Research Center (MRC) population represented the lower end of the scale due to its high density, summer confinement, and low productivity; and (3) a 1977 sample from GMU 15 was taken from a group of postparturient cows in extremely poor condition.

When GMU 22 moose blood collected in 1981 was compared to values from the 18 populations of Alaskan moose, it ranked 6th for PCV and Hb, and 5th for Ca (Table 8). However, the other 2 values were much lower; P ranked 14th and TSP ranked near the bottom at 16th. Using Franzmann and Schwartz's (1983) baseline populations for comparison, GMU 22 moose appeared to be in average condition in 1981. However, 2 of 5 values indicated possible stress. Franzmann et al. (1976) concluded that PCV and Hb are the 2 blood values that best represent overall physical condition in Alaskan moose. Because PVC and Hb, as well as Ca for Unit 22, were in the middle-to-high range, the moose population was probably in relatively good physical condition at the time of capture. However, because 2 of the 5 values were at the low end of the spectrum, this conclusion is uncertain. Franzmann and Schwartz (1983) pointed out that blood values should not be strictly interpreted according to rank; rather, the values provide an assessment of relative condition on a scale from good to poor. If values consistently fall on 1 end of the scale or the other, we can assume the moose population in question approaches this physical condition. Thus, the blood samples from 1981 did not provide conclusive evidence about the physical condition of Unit 22 moose.

Grauvogel (1980) pointed out that the density of GMU 22 moose on their winter range often exceeded 8 animals/km² (20/mi²), and the winter range has supported such a density for a number of years. Some deterioration in winter range condition has occurred or is likely to occur in the future. Because blood data from 1981 were inconclusive and because the quality of winter range food is unknown, blood samples were collected in April 1982 and again in 1983. Results from this work prompted additional collections in April 1984.

In April 1982, blood was collected from 10 additional bulls during radio-collaring, but only 5 blood samples were of sufficient quality to be analyzed. Mean PCV and Hb values were 39% and 15 g/dl, respectively. When these values are compared with the Alaskan moose populations in Table 8, they rank 12th, or near the low extreme. Mean PCV from the 1982 sample (39%) was significantly lower ($P < 0.02$, unpaired _t_-test) than the 1981 value (43%). Mean Hb concentration from the 1982 sample (15 g/dl) was also significantly lower ($P < 0.01$, unpaired _t_-test) than the 1981 value (17 g/dl). The winter of 1981-82 on the Seward Peninsula may have been more severe than previous years because of a midwinter thaw and associated rain which resulted in a thick ice crust. Such conditions made it difficult for moose to travel (animals were breaking through the snow crust and suffering abrasive injuries) and may have impeded efficient foraging. The differences in mean values of the 1981 and 1982 samples suggest that moose physical condition deteriorated from the previous year. The differences between years were striking enough to warrant further investigation.

Comparison of successive samples from the same group of moose is a more reliable method for detecting changes in physical condition over time, because it is free of variation due to differences between animals. In April 1983, blood was collected from 10 moose that were radio-collared in 1981. To determine the error due to laboratory analysis, 4 vials of blood were submitted separately for testing. Test results were generally consistent between vials. Means calculated from each of the 4 test vials were compared with test results from blood taken in 1981 (Table 9). Eight of the 10 animals showed decreases in PCV from 1981 to 1983, while all 10 animals showed decreases in Hb during this period. The decline in PCV from 1981 to 1983 was significant at the 90% level (paired _t_-test). (The test was not highly significant because moose No. 18 exhibited a 6.7% increase in PCV.) However, the decline in Hb was significant at the 99.9% level (paired t-test). These data suggest that the moose population was in poorer physical condition in late winter 1983 than in 1981 when radio-collaring began. I was surprised at this result because the winter of 1982-83 was mild and certainly less severe than the previous 2 winters in terms of snow depth and temperature extremes. I would, therefore, have expected that 1983 blood values would rank at least near, or higher than, values from 1981, unless the population is experiencing a long-term decline in physical condition.

Because blood results from 1981-1983 left a number of questions unanswered, additional follow-up work was warranted. In April 1984, blood samples were again collected from radio-collared moose. I wanted to obtain serial samples from the same moose we tested in 1983, but moose No. 3 and No. 37 had died, and we did not have an opportunity to immobilize No. 20. However, we collected blood samples from 9 moose; 6 had been previously tested in 1981 and 1983 and 3 had been tested in 1981. We collected 3-4 vials of blood per animal, but some samples were damaged by freezing and/or clotting due to the failure of the anti-coagulant. Only 1 and 2 vials could be analyzed from moose No. 16 and No. 19, respectively, and their quality was poor.

Mean values for PCV and Hb from 1984 were compared with test results from 1981 (Table 10). PCV decreased in 7 of 9 moose, and Hb decreased in 9 of 9 moose. The decline in PCV was only significant at the 80% level (paired t-test), but the decline in Hb was significant at the 99.9% level (paired t-test). Test results from 1984 also support the contention that moose were in poorer physical condition than when radio-collaring began in 1981. I find these results somewhat alarming. Snowfall during the winter of 1983-84 was very light. Moose were not concentrated on their main wintering areas as in past years. In fact, part of the population spent the entire winter in summer range areas because willows were not covered by snow and were easily accessible. Thus, if moose were nutritionally stressed, it was probably not due to an absolute shortage of browse, but to a scarcity of high quality browse or to other factors.

Mean PCV and Hb values for all moose tested in 1984 were 39.8% and 14.5 g/dl, respectively (Table 10). Compared with other moose populations in the state (Table 8) PCV ranked 9 out of 13 and Hb ranked 11 out of 13. Using 1984 values, the Unit 22 moose population ranked below average when compared to other Alaskan moose populations. Whether the observed decline in the physical condition of Unit 22 moose is a temporary condition or whether it is an ongoing long-term trend is unclear. However, 3 years of serial data indicate that the decline in

PCV and Hb occurred during relatively mild winters, and the reverse would be expected if the decline were related to variation in winter severity. If the data are correct, Unit 22 moose are experiencing a long-term decline in physical condition.

Hair Mineral Analysis

Hair mineral element analysis has also been investigated as a possible indicator of condition in moose (Franzmann et al. 1975, 1977; Flynn et al. 1977; Franzmann 1977) The "state of the art" was best summarized by Franzmann and Schwartz (1983) who pointed out that mineral metabolism studies of moose have given the wildlife manager 1 more tool with which to understand the dynamics of populations. They analyzed hair for 16 trace elements and found that 6 elements (zinc [Zn], copper [Cu], cobalt [Co], iron [Fe], potassium [K], and lead [Pb]) showed some relationship to general physical condition. Their data indicated that moose in better condition showed a greater intake of these elements, but variability between populations was considerable. Hair analysis did not provide conclusive evidence about moose condition, but in combination with other results, it did provide supportive assessment information.

Hair collected in April 1981 from 38 moose in Unit 22 was analyzed for 15 trace elements (Table 11). Table 12 presents the values for Zn, Cu, Co, Fe, K, and Pb obtained by Franzmann and Schwartz (1983) for each condition class (see Franzmann et al. [1976] for explanation of classes), and I have included the values obtained from Unit 22 moose for comparison. Element values are ranked numerically only for condition classes 4 through 9. Body condition classes of Unit 22 moose ranged from a low of 5 to a high of 8. Three values for Unit 22 moose (Zn, Co, and K) fell below condition class 4. On the other hand, Fe fell between condition classes 8 and 9, and Cu and Pb ranked between classes 5 and 6. Thus, if Franzmann and Schwartz's element table is used as a measure of condition, 3 of 6 elements indicated that Unit 22 moose in 1981 were in poor condition and 3 elements indicated average condition.

Franzmann and Schwartz's work is still preliminary, and the baseline values established for each element by condition class may not be applicable to trace element values obtained from Unit 22 moose. However, the preliminary indication is that 3 of the 6 trace elements were below normal. This information, together with the hematological data presented above, suggest the physical condition of Unit 22 moose in late winter is below normal, and may be declining.

Serologic Survey for Pathogens

Serum samples collected from 29 moose in 1981 and 18 samples collected in 1982 and 1983 were sent to the National Veterinary Services Laboratory, U.S. Department of Agriculture, Ames, Iowa and tested for 9 separate diseases: Brucella spp., Leptospira spp., contagious ecthyma (CE), epizootic hemorrhagic disease (EHD), bluetongue, infectious bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD), parainfluenza 3 (PI3) and Q fever. All moose tested were negative, with 3 exceptions: 1 moose (2% of sample) was positive for brucellosis by 1 method of testing but negative by another; and 2 moose (4% of sample) were positive for EHD. The incidence of infection in other Alaskan moose populations tested to date is: Brucella, 0.2% (2 pos./833 samples); Leptospira, 13% (11 pos./86 samples); CE, no occurrence (57 samples); Bluetongue, 3% (3 pos./101 samples); EHD, 3% (3 pos./101 samples); BVD, 8% (8 pos./97 samples); IBR, 1% (1 pos./95 samples); PI3, no occurrence (99 samples); and Q fever, no test comparisons (R. Zarnke, unpubl. data).

The data above indicate that Alaskan moose are relatively free of these 9 diseases. By comparison, Unit 22 moose exhibited a similar pattern with 2 minor exceptions. Brucella may be more prevalent in the Unit 22 moose population because the incidence of the disease is high in reindeer and their predators, and because these animals commonly occur throughout the Seward Peninsula, providing a source of infection to moose.

The significance of EHD in Unit 22 moose is presently unknown. The pathogen for EHD is a virus, and the antibody test used to detect the disease may give positive results from other viruses. Whether EHD actually occurs in moose is yet to be determined (R. Zarnke, pers. commun.).

The relatively disease-free status of Unit 22 moose was supported further by testing for sarcocystis. In 1979-80, I collected 89 heart tissue samples that were histologically prepared at a commercial laboratory. Only 2 of 89 (2.2%) moose were infected; in other Alaskan moose populations, the infection rate ranged from 7.7% to 66.6% (Neiland 1981). Neiland postulated that the substantial variation in prevalence of sarcocystis between different areas of the state must be related to exposure to predators, predominantly wolves. Because wolf numbers are relatively low in Unit 22, the incidence of diseases for which wolves act as the intermediate host should also be low.

Movements

Moose from the Kuzitrin and Agiapuk drainages exhibited similar movement patterns which fell into 2 general categories:

(1) sedentary animals who remained in the vicinity of their winter range and whose seasonal migration was predominantly to a different elevation or vegetation type; and (2) highly migratory animals whose seasonal movements covered large distances. LeResche (1974); Bailey et al. (1978); and Ballard and Taylor (1980) described similar movement patterns in other populations of Alaskan moose. A few animals exhibited movements intermediate between sedentary and highly migratory; however, I classified moose as sedentary if they moved less than 24 km (15 mi) from their point of capture during an annual cycle and highly migratory if they moved farther than 32 km (20 mi). Using this criterion, 7 of 37 moose (19%) were sedentary, 8 were intermediate (22%), and 22 were highly migratory (59%).

Seasonal movements of sedentary moose were predominantly changes in elevation; i.e., from riparian habitat along the main course of the river to higher elevations where vegetation was predominantly mixed shrub and willow associated with feeder creeks or tributaries. Moose classified as intermediate usually followed the same movement pattern as sedentary moose, but distances between their main wintering areas and their summer ranges were greater. Highly migratory moose often moved to different drainage basins, or their movements spanned most of the length of the drainage from the riparian lowlands to the headwaters.

In general, moose remained on their winter range through April. In contrast, studies of other Alaska moose populations revealed significant movements toward summer ranges in April (Bailey 1978; Ballard and Taylor 1980). April temperatures on the Seward Peninsula usually hover near freezing and snowmelt is light. In a year with normal snowfall, summer browse will be largely unavailable until May. During April, moose often move toward summer range, but typically follow a riparian course and remain on winter range while doing so. By late May, however, temperatures rise above freezing during the day, and snow cover becomes patchy, except for steep north-facing slopes, where it is usually continuous. Warming temperatures and the emergence of willows from snow cover appear to stimulate movement from winter range. The time required for movement between summer and winter range in this study depended on whether a moose was sedentary or migratory. Moose classified as migratory often traveled 50-100 km in less than 20 days, and would usually be on their summer range in late May or early June. Van Ballenberghe (1978) found that the date of parturition seemed to influence date of arrival on summer range for female moose. Impending parturition may influence the rapid travel of migratory females to summer range. However, parturition is not the sole reason for rapid movements of migratory moose to summer ranges, because bulls covered similar distances in the same time.

The timing of movements by sedentary moose were less predictable. Some animals spent May and early June foraging on winter range and did not move to higher elevations until late June or July. Sedentary and intermediate moose often took 2-6 weeks to travel from winter to summer range.

Movements of radio-collared moose to their summer range were predominantly north or east (300° through 90° magnetic) and usually toward higher terrain. Only 20% of the moose moved in a southerly direction, and only 11% moved south more than 16 km (10 mi). Figure 2 illustrates dispersal routes from winter to summer ranges and the maximum distance traveled by each instrumented moose during an annual cycle. Moose often followed an erratic course when traveling to and from their winter ranges; however, for graphic purposes, the routes are shown as straight lines.

Moose returning from summer to winter range usually began moving in early November and continued their migration through January, but movements were highly variable from year to year and between individuals. Snow accumulation was undoubtedly the single most important factor in determining the timing and duration of movements to winter range. The importance of snow in influencing moose movements has been reported for other populations of moose (Edwards and Ritcey 1956; Rausch 1958; LeResche 1974; Bailey et al. 1978; Van Ballenberghe 1978; Ballard and Taylor 1980). From 1973 to 1983 I flew aerial surveys in late fall to determine moose composition and observed that when snow was heavy during October and November most moose moved to winter ranges; conversely, when snow cover was very light, most moose remained on summer ranges though November and December.

Snow cover was moderate during November and December 1982 (81 cm) and very light during November and December 1983 (41 cm, mostly melted by rain). During aerial surveys in fall, I observed 94 moose per hour in 1982 and only 47 per hour in 1983. Moose were widely scattered during winter 1983-84 and remained predominantly in summer areas through December. Because of light snow cover, 20-30% of the population remained on traditional summer range during the entire winter. Van Ballenberghe (1978) found that migratory movements were reduced in winters with light snow cover and that moose remained longer in summer areas.

Cold temperatures may also stimulate moose to move to winter range, but I believe this relationship to be indirect on the Seward Peninsula. January and February 1984 were record cold months. Nome's mean February temperature in 1984 was -26°C, a departure of -14°C from the normal mean February temperature of -12°C. Mean wind speed was 11.6 km/hr. Even with such cold temperatures and windchill, moose remained in mountainous summer terrain. Moose were still able to find shelter from the wind because of the light snow cover. In a year with normal snowfall, the only cover that will provide a suitable windbreak is located on winter range, where willows are taller than on the summer range. Cold temperatures and windchill probably stimulate moose movements, but their importance is minor when snow cover is light.

To illustrate seasonal activity patterns of Unit 22 moose, mean distance traveled from point of capture (winter range) was plotted monthly from April through March (Fig. 3). Movements of bulls and cows were synchronous. Longest movements from winter range occurred during June, followed by another peak of activity at the onset of the rut in September and October. A gradual reduction in activity occurred after October as moose moved toward winter range.

Maximum distance radio-collared moose moved from point of capture ranged from 9.6 to 96.5 km (5.5-60 mi); distances between winter and summer ranges varied from 6 to 80 km (4-50 mi). Mean distance was 13 km (8 mi) for sedentary/intermediate moose and 48 km (30 mi) for migratory moose. Distances traveled by Unit 22 moose between summer and winter were in the middle-to-high range compared to other Alaskan moose populations. Moose in southcentral Alaska (Unit 13) moved 8-94 km (5-58 mi) (Van Ballenberghe 1978); in another portion of Unit 13 (Susitna drainage), migratory moose moved 16-93 km (10-58 mi) (Ballard and Taylor 1980); in Unit 16 moose moved 3-19 km (2-12 mi) (Didrickson and Taylor 1978); and on the Kenai Peninsula migratory moose moved 2-60 km (1-37 mi) (Bailey et al. 1978). Mean distance between sightings, closest distance that moose returned to their point of capture, maximum distance from point of capture, and longest distance between consecutive observations were similar for both bulls and cows (Tables 13 and 14).

Sedentary/intermediate moose in Unit 22 moved a mean distance of 11.3 km (7.0 mi) between sightings compared with 19 km (11.8 mi) for migratory moose. The mean for both groups combined was 15.9 km (9.9 mi) (Tables 13 and 14). Radio-collared moose were located approximately once every 6 weeks, and occasionally more frequently during spring and fall migration. Therefore, mean distance traveled between sightings approximates mean distance each month from point to point.

The longest distance traveled between consecutive observations ranged from 11.3 to 96.5 km (7.2-60 mi) and averaged 43.3 km (25.9 mi). By comparison, mean distance between consecutive observations for a highly migratory moose population in Unit 13 was 27.9 km (17 mi) (Ballard and Taylor 1980). Moose studied in Unit 13 were located more frequently, thereby reducing mean distance between observations. However, methodology is probably not the sole reason for the difference. A larger percentage of the Unit 22 moose population is highly migratory, distances between seasonal ranges are covered very quickly and moose therefore move greater distances between consecutive observations.

Overall, seasonal fidelity to the same winter range was high. During the 1st winter following radio-collaring, 29 of 32 moose (for which records cover 1 year or more) returned to the winter range where they were captured. Twenty-two moose (69%) returned to within 6 km (4 mi) of their point of capture. During the study, all radio-collared moose eventually returned to the drainage where they were captured. However, 3 moose (Nos. 2, 10, and 15) migrated from Subunit 22D to other subunits during June 1981 and remained in those areas during winter 1981-1982. Two of the 3 returned to the winter range of their capture in 1982-83. The 3rd died. I originally believed these moose were colonizing new home ranges, but it now appears they used these areas only as alternate winter and summer ranges. This pattern was also exhibited by moose Nos. 30, 35, and 53. These moose spent most of the year on their summer range and only brief periods on winter range, often moving back to summer range in the middle of winter. (Individual moose movements can be reviewed in Appendix A.) Van Ballenberghe (1978) found that during years of below-normal snow accumulation, many moose remained on summer range throughout the year. I don't believe that snow cover is the principal reason Unit 22 moose often stayed on (or moved to) summer range during the winter months, because sometimes snow cover was moderate-to-heavy during these occurrences. The use of alternate winter and summer ranges may have adaptive value as a means for testing and colonizing areas of suitable habitat.

Home Ranges

Annual and seasonal home ranges were determined by constructing a polygon from the outermost points of all relocations (Mohr 1947). Summer was defined as May-October and winter as November-April. Other investigators working in interior and northcentral Alaska have used April-September as the summer season and October-March as the winter season. However, emergence of vegetation on the Seward Peninsula during spring is 1 month to 6 weeks later than in the interior, and it is more realistic to begin the summer period in May .

Some investigators have computed summer and winter home ranges by eliminating migratory locations, which include some September and October movements to rutting areas (Ballard and Taylor

1980). I did not do this, because my primary goal was to determine the area used (or required) during the entire annual cycle. In addition, moose often move erratically during the year, and elimination of data points becomes subjective.

Annual home ranges of 37 radio-collared moose (with movement data spanning at least 12 months) were highly variable, ranging in size from 91 to 1,931 km^2 (35-746 mi^2); the mean was 748 km^2 (289 mi^2) for bulls and 606 km^2 (234 mi^2) for cows (Table 15). Home ranges reported for other Alaskan moose populations are as follows: in Unit 15 (Kenai Peninsula), 3 subpopulations ranged from a low mean of 27 km^2 to a high mean of 92 km^2 (Bailey et al. 1978); in Unit 13 (Upper Susitna Valley), individual home ranges varied from 4 to 2,011 km^2 (2-1,124 mi^2) and averaged 224 km^2 (87 mi^2).

Annual home ranges of sedentary moose on the Seward Peninsula varied from 91 to 350 km^2 (35-135 mi^2), averaging 217 km^2 (84 mi^2); home ranges of intermediate moose varied from 202 to 503 km^2 (78-229 mi^2); and home ranges of migratory moose varied from 236 to 1,931 km^2 (91-746 mi^2) and averaged 937 km^2 (362 mi^2) (Table 16). In general, home range size increased in area with increasing distance between summer and winter range. Thus, sedentary moose had, on average, a smaller home range than migratory moose. Sizes of summer and winter home ranges also showed a similar trend, increasing when moose were migratory.

A principal objective of this study was to determine if moose from the Agiapuk and Kuzitrin drainages disperse throughout Subunit 22D moving as 1 homogeneous group, (defined for this discussion as a single population), or whether moose from these 2 drainages confine their movements to separate geographic areas with little or no interchange occurring between the 2 drainages (defined for this discussion as a subpopulation). To determine if moose in Subunit 22D are a single population or whether they comprise 2 or more subpopulations, home ranges of moose radio-collared in the Agiapuk and Kuzitrin drainages were analyzed separately. Home range polygons from each drainage were combined to form 2 large composite polygons (Fig. 4). Each polygon represents the total area used by radio-collared moose in each drainage. The area of the composite polygon formed from 18 radio-collared moose in the Agiapuk was 6,019 km^2 (2,324 mi^2), and the area of the polygon formed by 19 moose in the Kuzitrin drainage was 6,000 km^2 (2,317 mi^2).

From an inspection of Figure 2, it is apparent that moose from the 2 drainages, though not entirely separate subpopulations, are nearly so. The amount of overlap between the 2 polygons is 1,406 km^2 (544 mi^2), approximately 13% of the total area.

However, the percentage is slightly misleading because it does not represent the number of moose involved in the overlap, only the area of home range overlap. Most of the area overlap resulted from the home range intersection of 1 or 2 moose. But 4 moose collared in the Kuzitrin (Nos. 19, 20, 27, and 37) crossed into the Agiapuk drainage and 5 moose collared in the Agiapuk crossed into the Kuzitrin drainage. However, these crossings occurred in summer range areas along a common drainage divide.

The population discreteness of moose from the 2 drainages is better illustrated by comparing polygons of winter and summer range. The overlap of summer range polygons was 3.9% of the total area, (Fig. 5) and overlap of winter range polygons was only 1.3% of the area (Fig. 6). Figures 5 and 6 indicate that moose from the 2 drainages used different summering and wintering areas. Based on the definitions established previously, moose in the Agiapuk and Kuzitrin drainages should be classified as subpopulations.

Moose from the Agiapuk and Kuzitrin both had larger summer home ranges than winter home ranges. Combined summer home range area of 18 moose from the Agiapuk was 2,938 km^2 (1,135 mi^2), compared to 1,875 km^2 (724 mi^2) for winter. Summer home range area of 19 moose from the Kuzitrin drainage was 3,694 km^2 (1,427 mi^2), compared to 2,188 km^2 (1,232 mi^2) in winter.

To provide an index of moose density on winter and summer range, maps were prepared by stacking home ranges of all moose on top of one another. Maps were gridded into 1/4 townships (23 km^2/9 mi^2) and the number of home ranges covering each grid square was recorded. Each square was then given a home range density ranking as follows: low, 1 overlap; medium, 2-3 overlaps; and high, at least 4 overlaps (Figs. 7 and 8).

The highest winter range density occurred adjacent to the Agiapuk and Kuzitrin rivers and along major tributaries (Fig. 7). Highest summer range density occurred at the headwaters between the Agiapuk and Kuzitrin drainages (Fig. 8). This seasonal distribution was not unexpected, because similar densities were observed during moose composition counts from 1971-1984. However, 1 striking characteristic of Figures 7 and 8 is the large area that Unit 22 moose utilize, both in winter and summer. When moose were 1st radio-collared in April 1981, they were captured from a small linear strip approximately 65 km^2 (25 mi^2) long, but during the following 2 summers they occupied an area of approximately 10,600 km^2 (3,670 mi^2). The large size of the area is another indication of the highly migratory nature of Unit 22 moose.

Analysis of all movement and home range data indicates that moose from the Agiapuk and Kuzitrin rivers are 2 subpopulations (a subpopulation being a group of moose utilizing the same general winter and summer range and moving synchronously to and from those ranges (Ballard and Taylor 1980). These 2 subpopulations are only loosely differentiated, however, because both are highly mobile, and considerable interchange occurs between the 2 groups, particularly in summer and fall.

Reproductive History and Productivity

To ascertain reproductive success of Unit 22 moose, radio-collared cows were monitored to determine initial calving success and survival of calves to 1 year of age. Pregnancy rate of Unit 22 moose is apparently high. I collected 30+ reproductive tracts between 1973 and 1975 and found that all cows killed after November had 1 or more fetuses. In addition, all radio-collared cows were pregnant when palpated in April 1981.

Yearling recruitment from these cows was high; 64% were accompanied by 1 or more yearlings when they were captured. The reproductive history of each radio-collared cow from April 1981 through January 1984 (33 months) is illustrated in Table 17. The status of each cow with respect to its offspring is depicted sequentially 4 times during the year: May/June (number of neonatal calves observed); August/September (number of calves alive after summer); November/December (number of calves surviving through early winter); and April (number of calves surviving to 10 months of age [short yearlings]).

Initial calving success in May/June was generally high. In 1981, 22 cows produced 26 calves (118 calves:100 cows); in 1982, 20 cows produced 24 calves (120 calves:100 cows); and in 1983, 14 cows produced 11 calves (70 calves:100 cows). Calf mortality from May through November was 35% in 1981 (9 of 26), 42% in 1982 (10 of 24), and 45% in 1983 (5 of 11). These values are minimum estimates because they do not include data from cows that were never sighted with offspring. For example, in 1981, 6 cows (Nos. 1, 10, 15, 17, 18, and 19) probably gave birth, as they were pregnant in April, but the calf died apparently between observations. During the study, mortality of calves from June through November was probably closer to 50%. One significant finding from this study was that a calf has a high probability of living to 1 year of age if it survives until November. During 3 reproductive seasons, only 3 of 37 calves (8%) died after November. Calf mortality was low during all 3 winters. From November through April in 1981-82, calves:100 cows declined from 77 to 68; in 1982-83, the ratio declined from 78 to 76; and in 1983-84 there was no mortality (Table 17).

Calf mortality among radio-collared migratory moose was greater than calf mortality among radio-collared sedentary/ intermediate moose. At the end of 3 reproductive seasons, 7 migratory cows recruited 17 yearlings and 7 sedentary/ intermediate cows recruited 23 yearlings. Although sample sizes are small and it is premature to make a positive conclusion, calf survival may be lower if cows migrate long distances, compared to cows with a small home range.

Data from blood analysis indicated a decline in physical condition of moose from 1981-1984. Survival of calves from radio-collared cows also declined during the same period, perhaps coincidently (Table 17). Fall composition data from the Kuzitrin and Agiapuk drainages indicate that a decline in calf productivity and/or survival has occurred in the moose population during the last 13 years. From 1971-83, the percentage of mature cows (age 2+) with calves has declined (Table 18). To determine if this decline also occurred during the study, the percentage of cows with calves from 1973-1981 was compared to the percentage of cows with calves from 1982-83 with a chi-square test for difference in proportions. In the Agiapuk drainage the decline was significant ($P < 0.05$) and in the Kuzitrin drainage the decline was highly significant ($P < 0.001$).

The reason for the decline in calf productivity and/or survival is unknown. Data from radio-collared cows indicate that most calf mortality occurs during the summer and early fall, not during winter. Therefore, poor nutrition would not seem to be the primary cause. Another possibility is an increase in rates of predation. My personal observations indicate wolf numbers to be relatively low (20-40 in Subunit 22D); however, this represents an increase over the last 10 years. The grizzly bear population has remained stable during this period. Because moose are more numerous than 10 years ago, bears may have learned to become more efficient predators, especially on young moose. Ballard et al. (1980) found that 79% of calf mortality during summer in Unit 13 was due to grizzly bear predation. I believe the decline in calf survival In Subunit 22D is due to a combination of 2 factors: (1) a gradual decline in physical condition of cows, resulting in calves with less vigor and lower survival; and (2) increased predation from bears and wolves.

Mortality

Mortality of radio-collared moose was estimated according to the formula $M = \frac{a}{b} \times 100$ (Gasaway et al. 1983), where "a" is the number of mortalities among radio-collared animals during a specific time period, and "b" is the estimated number of collared animal periods (in this case, 12-month moose years).

From April 1981 to October 1984, data are available for 42 individual moose (21 cows and 21 bulls) who survived for at least 12 months. Annual mortality of bulls and cows combined was 14.5% (4.5% natural and 10% shot). Mortality among cows was 10.5% (8.4% natural and 2.1% shot). Bulls experienced the highest mortality (21% annually) and all were killed by hunters. Although this percentage seems high, it is not unexpected, considering the heavy hunting pressure in Subunit 22D. During the 1983-84 hunting season the reported harvest from this one subunit was 178 moose (114 bulls, 41 cows and 23 unspecified). I estimate the moose population in Subunit 22D to be 1,500-2,000 moose. Fall composition counts in 1983 revealed 52 bulls:100 cows. Assuming bulls number 513-684 (34% of 1,500-2,000), a harvest of 114 bulls is equivalent to a mortality rate of 17-22% annually. Mortality data from the hunter harvest and radio-collaring data indicate that the life expectancy of a bull in Subunit 22D is less than 6 years. Mortality of bull moose from the Kuzitrin population is higher than the Agiapuk, primarily because the Kuzitrin basin has better access and greater hunting pressure. Higher mortality in the Kuzitrin area was also substantiated by radio-collaring data. Five moose radio-collared in the Kuzitrin area were killed by hunters versus 3 radio-collared moose in the Agiapuk area. However, sample sizes are small and this difference is easily attributable to chance alone. Data from radio-collared moose and hunter harvest both suggest that annual mortality among bulls is high (15-23%).

MANAGEMENT RECOMMENDATIONS

Although moose from the Agiapuk and Kuzitrin are separate sub-populations, I do not recommend managing them on a strictly independent basis. They share several common denominators, and actions that affect one will often influence the other. Both populations are highly mobile during September and October when hunting pressure is heaviest. Most hunting occurs along transportation corridors (roads and rivers), but moose are continually crossing these corridors, providing hunters with an opportunity to harvest a high percentage and large cross-section of the population. Presently, annual mortality in the Kuzitrin is high, and the population is at or near the sustainable number for the condition of the habitat. Harvesting a high percentage of migratory moose from both populations could select for sedentary moose by modifying behavior or by genetic selection. In addition, high harvest over time could reduce the tendency of migratory moose to move from an area of high population density (such as the Agiapuk) to an area of lower density (such as the heavily hunted Kuzitrin or Subunit 22B). Thus, incidences of immigration would be reduced.

During the 12 years that I have observed moose movements on the Seward Peninsula, it seems apparent that fall migration patterns have changed, producing changes in behavior as a result of large harvests. In the early 1970's, moose commonly arrived on Kuzitrin winter range areas in early October. Some of these movements were undoubtedly related to rutting behavior; highly migratory bulls were probably moving long distances from summer range to establish rutting areas near winter range. Kuzitrin winter range is more accessible to hunters than summer range, and bulls moving early to winter range are more likely to be killed than bulls remaining near summer range during rut. Hunting effort and success increased dramatically on the Kuzitrin drainage from 1970-1980. The life expectancy of a bull with a tendency to move to winter range early was short compared to bulls who moved to winter range in late November and December. Currently, most bulls move to winter range after November. I believe that large harvests were in part responsible for producing this shift in behavior (mild winters may also be a factor).

Moose from the Agiapuk and Kuzitrin drainages regularly move to other subunits where they are occasionally harvested. The reported harvest of moose from these populations underestimates actual harvest. Therefore, it would not be wise to manage both populations for a high sustained yield; preferably, the Agiapuk population should be managed at a lower sustainable yield to provide a buffer against possible overharvest. In addition, migratory moose from lightly hunted areas (such as the Agiapuk drainage) would provide colonizing stock for heavily hunted areas in 1 of 3 ways:

1. by use of alternate winter and summer ranges;

2. by temporary movements through such areas during spring and fall migration; and

3. by permanent dispersal (probably by offspring of highly migratory dams).

A surprising result of this study was the large area which radio-collared moose used during an annual cycle. The composite home range for moose in the Kuzitrin was 6,000 km^2 (2,317 mi^2). This area was determined from the home ranges of only 18 moose; the area used by all moose in the Kuzitrin subpopulation would be considerably larger. I believe that moose in the Kuzitrin subpopulation require an area larger than the entire Kuzitrin drainage basin. The Agiapuk subpopulation also occupies a larger area than was previously thought. Because of the highly migratory nature of Unit 22 moose, it is unrealistic to manage these animals on a small drainage-by-drainage basis. This study has shown that moose in Subunit

22D range over a wide area, utilizing all habitats from river bottoms to alpine areas. This information should be considered when the public demands to harvest moose to the maximum extent possible in every drainage and when large-scale development is planned for the Seward Peninsula. Not all development is incompatible with effective moose management, but depending on the magnitude and type, some projects could have a serious impact on moose populations. Because most of the moose population is concentrated along the rivers during winter, major developments on winter range should be discouraged, especially if they substantially increase human activity in those areas. In general, transportation corridors should follow ridges and hilltops, rather than river channels. Transportation corridors should be planned well ahead of development and kept to a minimum. Because the moose population is highly mobile, a single direct corridor is preferable to several corridors with spurs radiating in many directions.

Preliminary results from hematological and serological work indicate that moose may be stressed in late winter. Blood sampling from marked animals should be continued to monitor trends in physical condition. The observed decline in general condition and productivity is probably related to a deterioriation in the quality and quantity of winter browse. Ideally, a comparative browse study should be initiated to assess several basic management questions:

1. Is winter range browse nutritionally deficient?

2. Will browse rehabilitation improve the quality of winter range?

3. Will browse rehabilitation improve the quantity of winter range?

4. Is a range rehabilitation program economically feasible on a large scale?

5. If question 4 is true, then what are the best methods?

If results from browse studies indicated extensive range overutilization, a reduction of the moose population might be warranted in some areas on an experimental basis. However, a population decline may be imminent anyway. If predator densities remain constant and calf production continues to decline, it will be difficult to sustain existing moose numbers in the Kuzitrin without reducing the harvest.

At present, there is insufficient information to determine whether moose should be managed at existing numbers or whether the best long-range management option is to reduce numbers. A substantial reduction in moose numbers would provide an opportunity for browse to recover, but the length of time to accomplish this goal and the effectiveness of any browse recovery program is unknown. Because demand for moose is high, the preferred management option at this time is to adjust harvest so that collective mortality in the Kuzitrin does not exceed annual recruitment. Hunter-caused moose mortality in the Agiapuk drainage should be maintained below annual recruitment. This plan should prevail until additional information indicates a different course of action.

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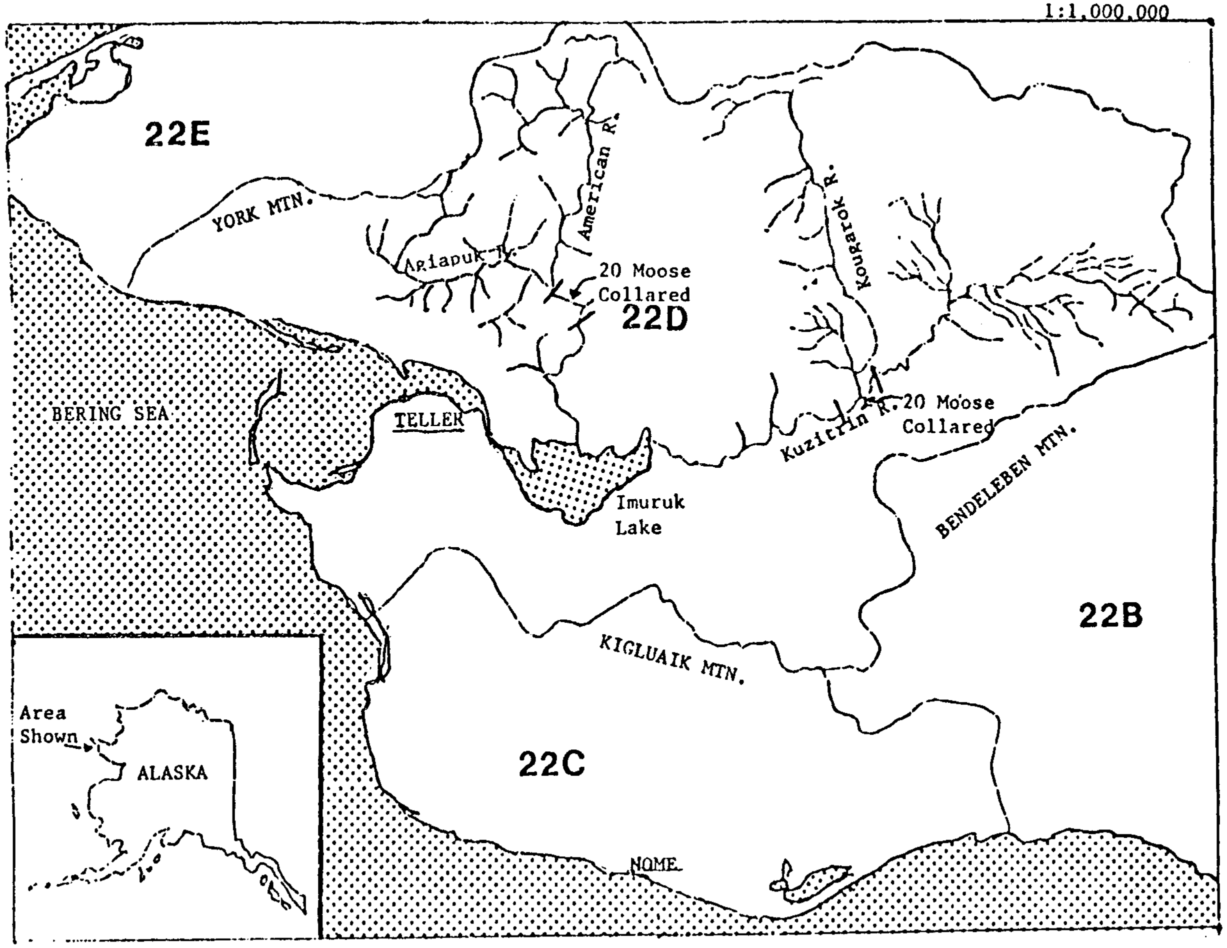

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Fig. 1. Seward Peninsula, showing Unit 22 study area.

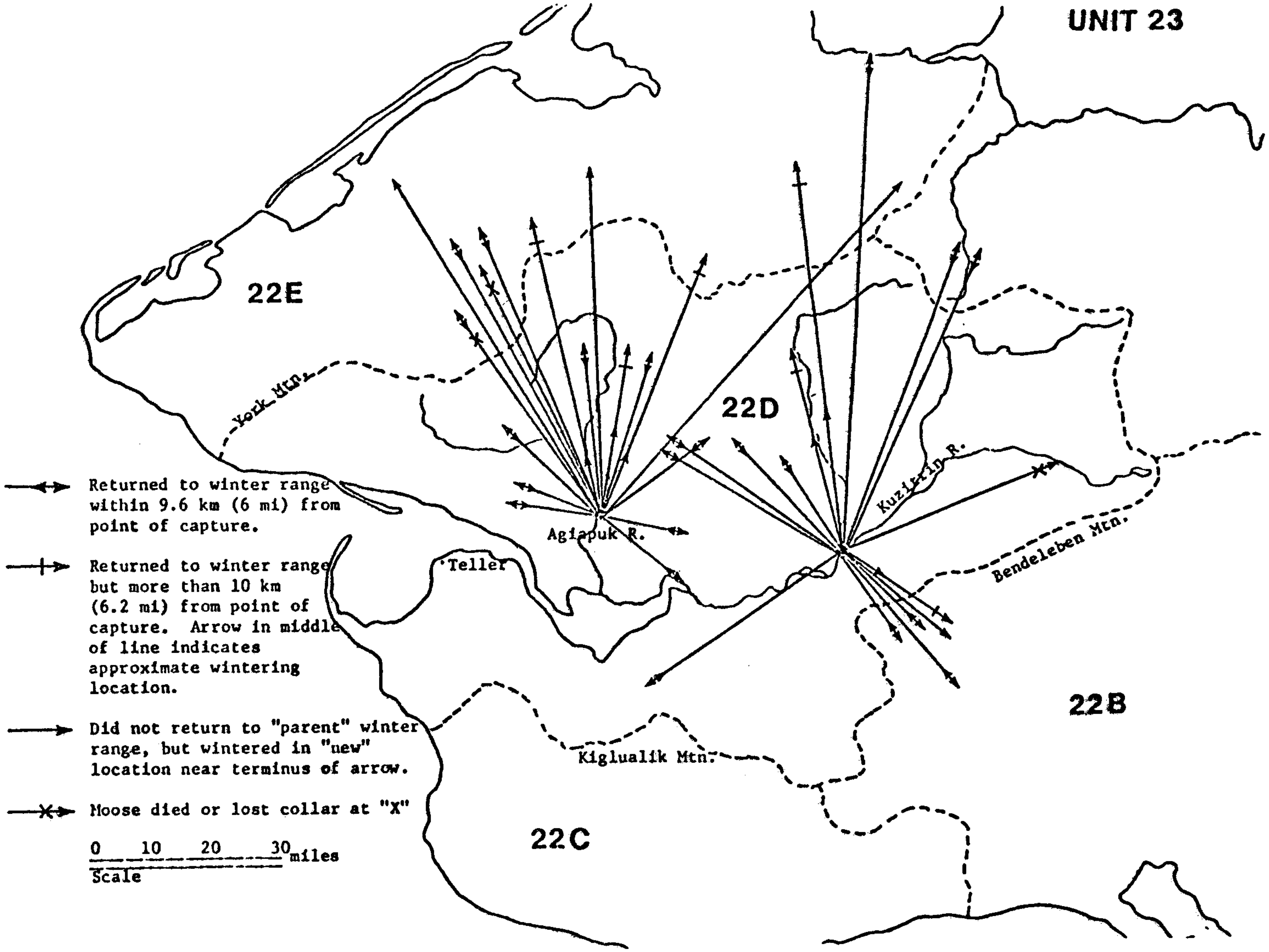

Fig. 2. Annual movements of Unit 22 moose from their winter range.

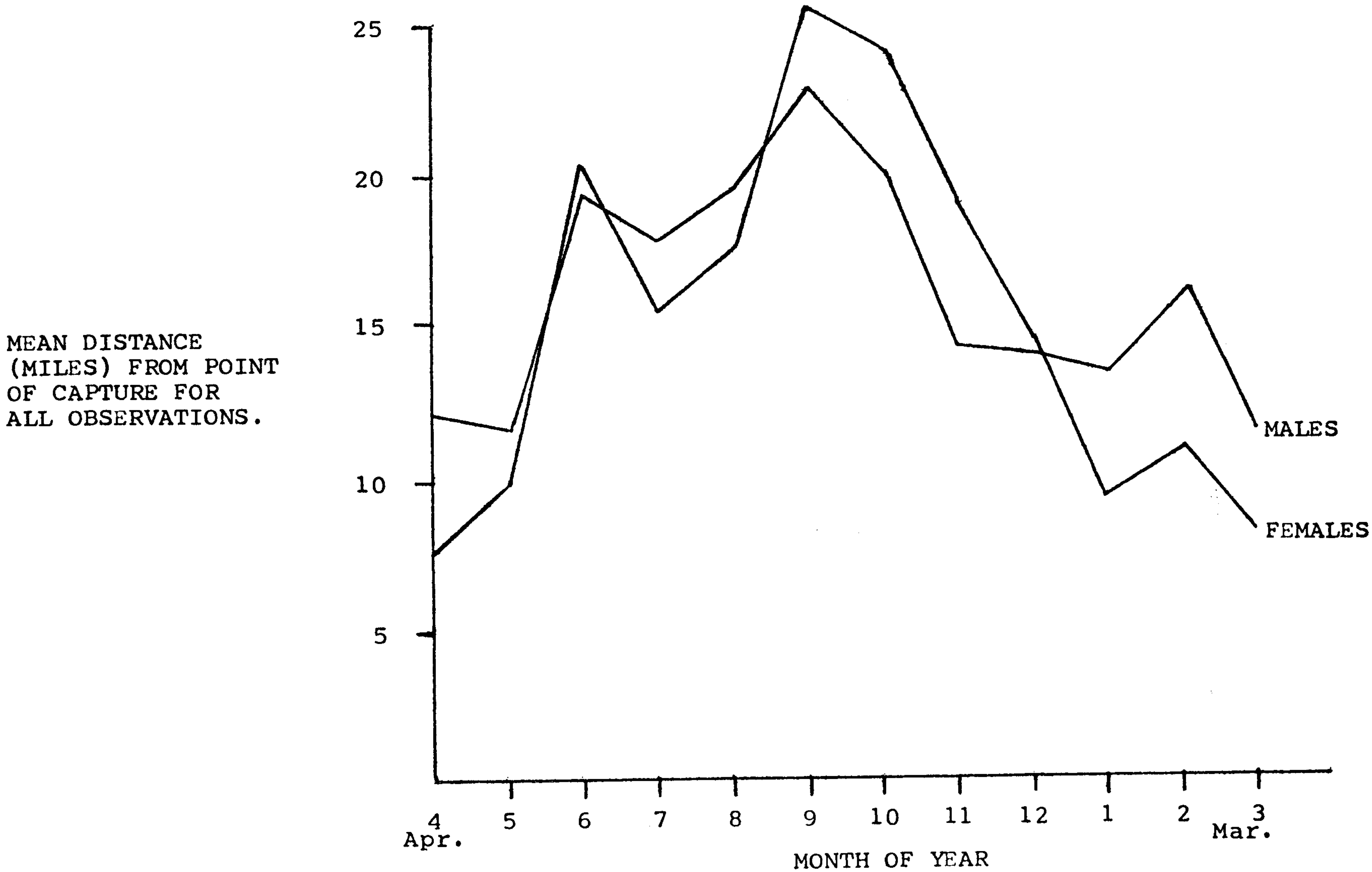

Fig. 3. Seasonal activity patterns of Unit 22 moose from point of capture (winter range).

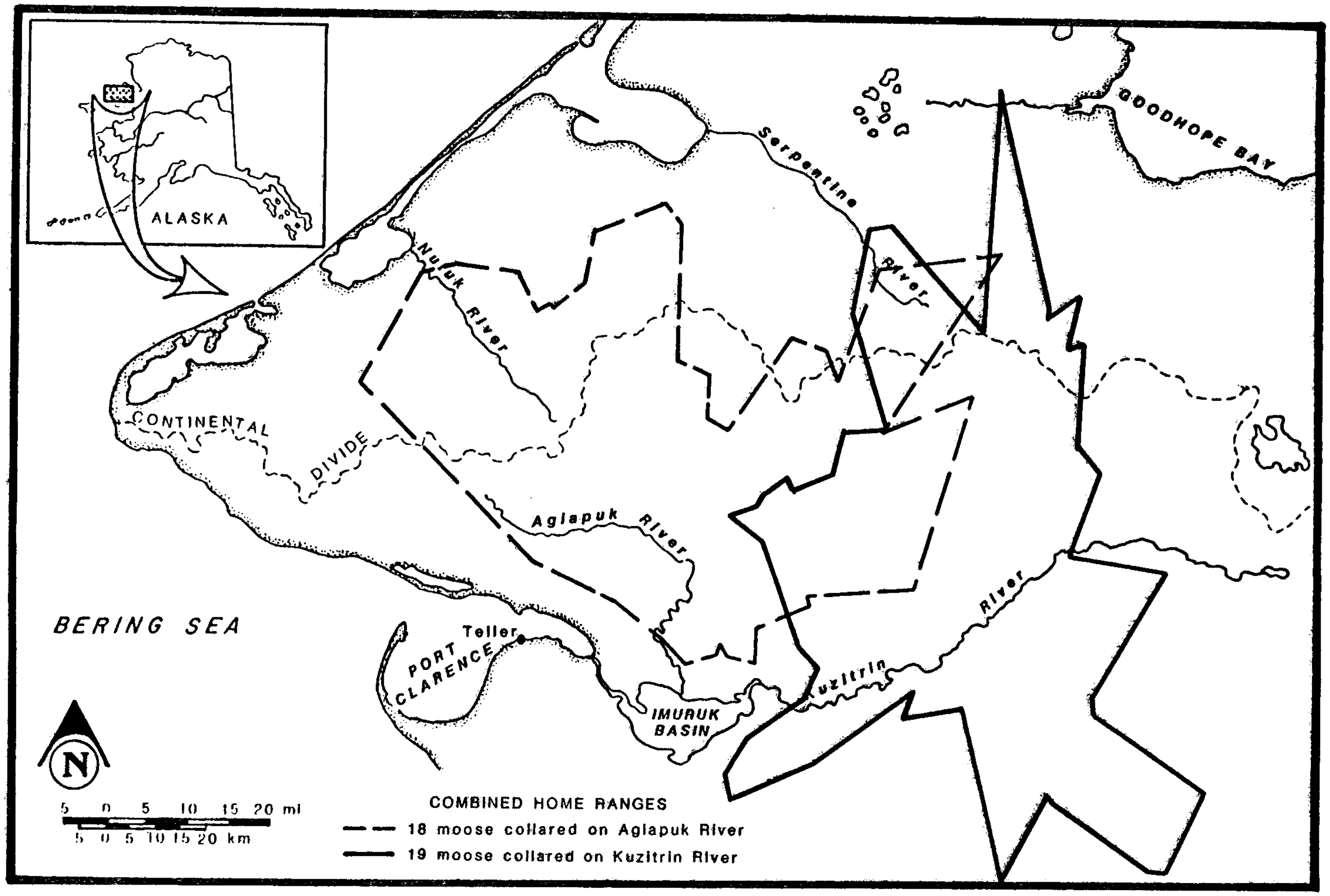

Fig. 4. Composite home ranges of radio-collared moose from the Agiapuk and Kuzitrin populations.

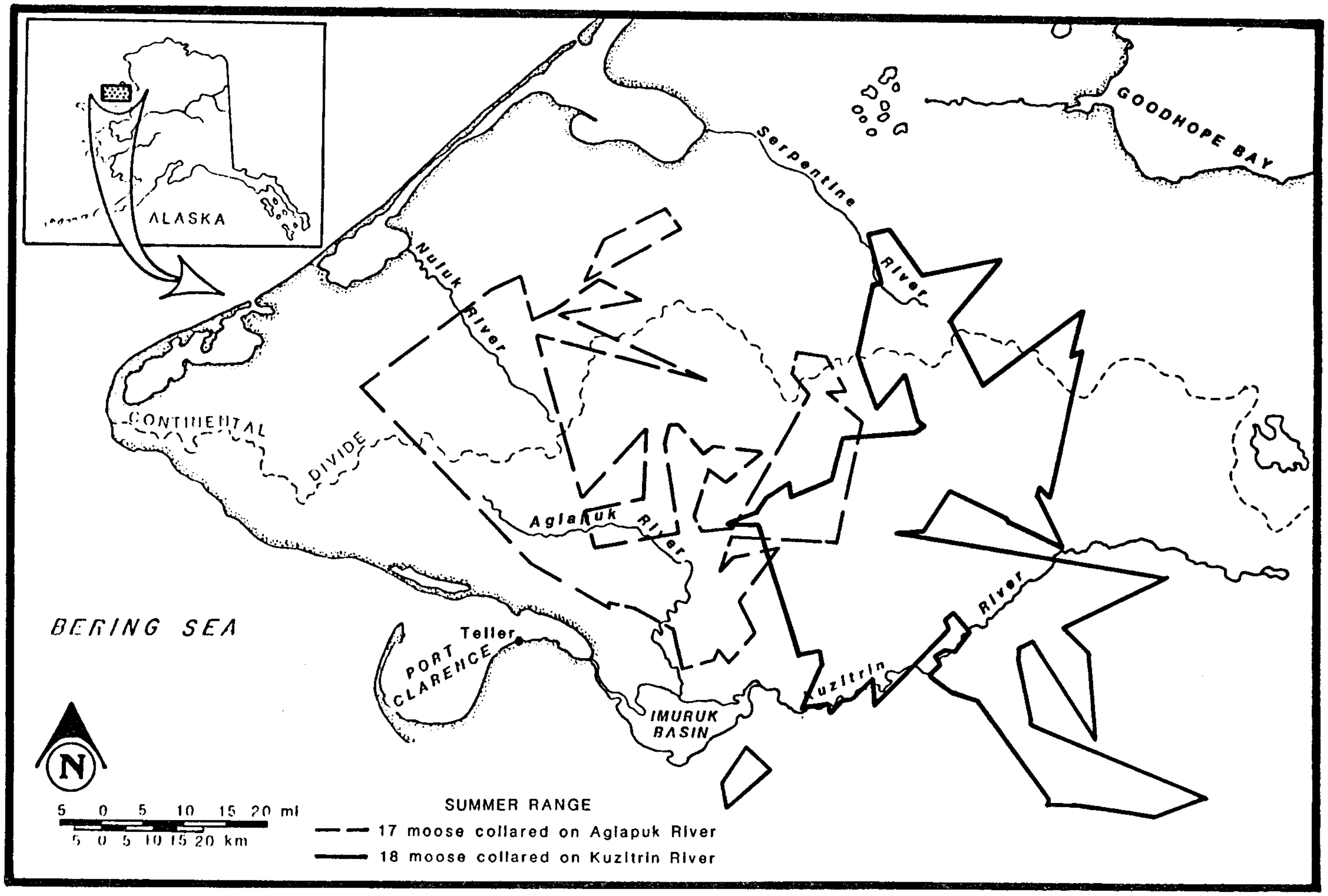

Fig. 5. Composite summer ranges of radio-collared moose from the Apiapuk and Kuzitrin populations.

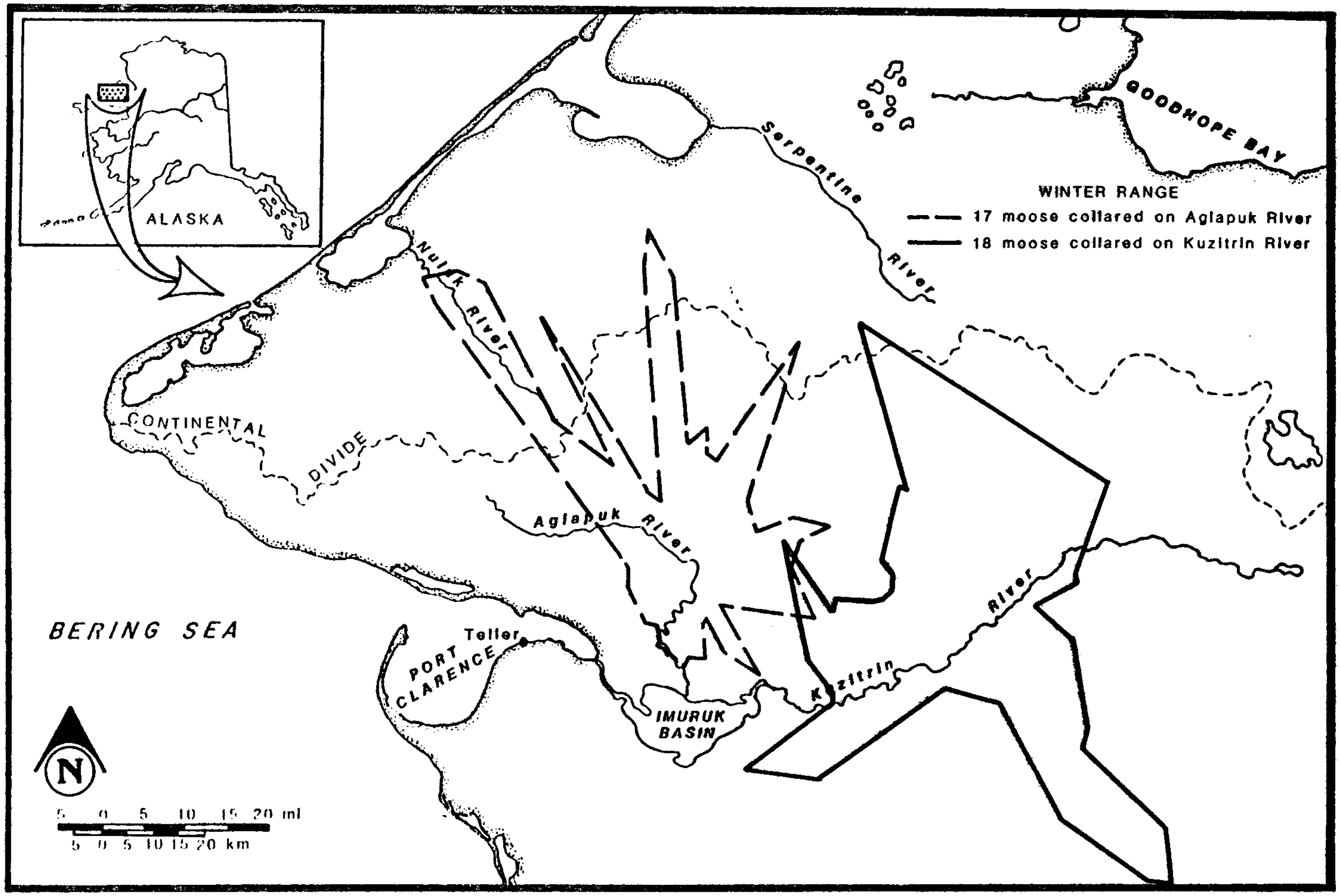

Fig. 6. Composite winter ranges of radio-collared moose from the Agiapuk and Kuzitrin populations.

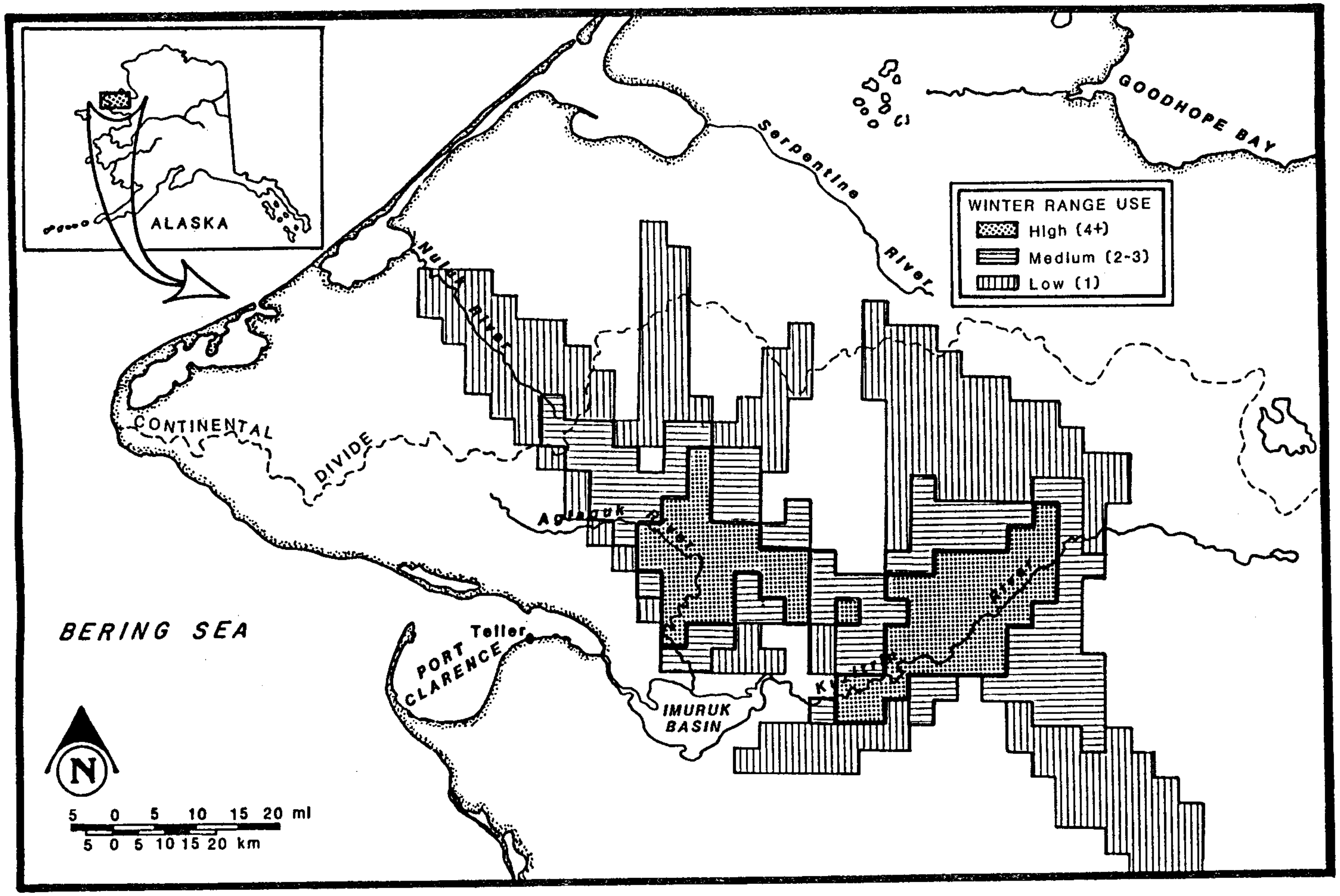

Fig. 7. Winter range density of radio-collared moose from the Agiapuk and Kuzitrin populations.

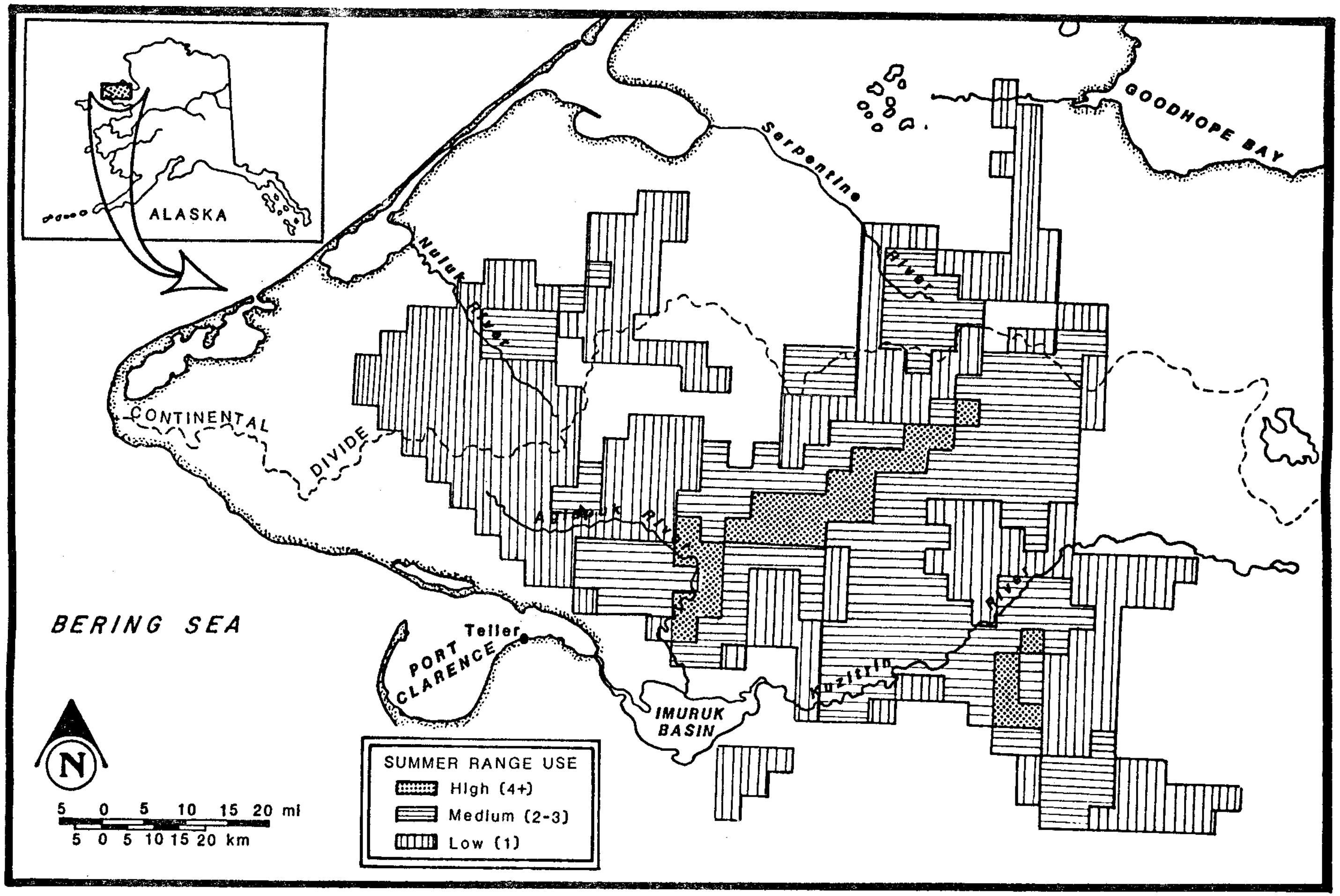

Fig. 8. Summer range density of radio-collared moose from the Agiapuk and Kuzitrin populations.

Table 1. Ten criteria used to assess body condition of moose. (Franzmann et al. 1976).

Class 10.	A prime, fat moose with visibly thick, firm rump fat. Well fleshed over back and loin. Shoulders are round and full.
Class 9.	A choice, fat moose with evidence of rump fat by feel. Fleshed over back and loin. Shoulders are round and full.
Class 8.	A good, fat moose with slight evidence of rump fat by feel. Bony structures of back and loin not prominent. Shoulders well fleshed.
Class 7.	An "average" moose with no evidence of rump fat, but well fleshed. Bony structures of back and loin evident by feel. Shoulders with some angularity.
Class 6.	A moderately fleshed moose beginning to demonstrate <u>one</u> of the following conditions: (a) definition of neck from shoulders; (b) upper foreleg (humerus and musculature) distinct from chest; or (c) rib cage is prominent.
Class 5.	A condition in which <u>two</u> of the characteristics listed in Class 6 are evident.
Class 4.	A condition in which all <u>three</u> of the characteristics listed in Class 6 are evident.
Class 3.	A condition in which the hide fits loosely about neck and shoulders. Head is carried at a lower profile. Walking and running postures appear normal.
Class 2.	Signs of malnutrition are obvious. The outline of the scapula is evident. Head and neck low and extended. The moose walks normally but trots and paces with difficulty, and cannot canter.
Class 1.	A point of no return. A generalized appearance of weakness. The moose walks with difficulty and can no longer trot, pace or canter.
Class 0.	A dead moose, from malnutrition and/or accompanying circumstances.

Table 2. Body measurements of bull moose from Unit 22, 1981-82.

Moose No.	Date captured	Age	Total length cm	Total length in.	Hind Foot cm	Hind Foot in.	Girth cm	Girth in.	Height shoulder cm	Height shoulder in.
21	4/15/81	8	298	117.3	--	--	206	81.1	--	--
22	4/15/81	6	298	117.3	81	31.9	202	79.5	--	--
23	4/14/81	7	302	118.9	--	--	221	87.0	--	--
24	4/16/81	3	245	96.5	88	34.6	182	71.7	--	--
25	4/15/81	3	299	117.7	91	35.8	208	81.9	--	--
26	4/15/81	11	287	112.9	93	36.6	203	79.9	--	--
27	4/15/81	4	287	112.9	91	35.8	191	75.2	--	--
30	4/16/81	unk	298	117.3	91	35.8	206	81.1	--	--
31	4/15/81	5	279	109.8	89	35.0	178	70.1	--	--
32	4/16/81	3	312	122.8	85	33.5	211	83.1	--	--
34	4/16/81	7	277	109.0	--	--	196	77.2	--	--
35	4/15/81	2	246	96.9	89	35.0	163	64.2	--	--
36	4/15/81	6	295	116.1	88	34.7	188	74.0	--	--
37	4/14/81	3	300	118.1	88	34.7	202	79.5	--	--
38	4/16/81	4	299	117.7	91	35.8	206	81.1	--	--
39	4/15/81	unk	309	121.7	--	--	192	75.6	--	--
40	4/14/81	8	315	124.0	86	33.9	170	66.9	--	--
44	4/16/81	6	305	120.1	94	37.0	213	83.9	--	--
50	4/27/82	3	305	120.1	85	33.5	--	--	169	66.5
51	4/27/82	2	298	117.3	85	33.5	198	77.9	155	61.0
52	4/27/82	2	314	123.6	87	34.3	203	80.0	158	62.2
54	4/27/82	1	274	107.8	82	32.3	178	70.1	161	63.4
55	4/27/82	3	318	125.2	88	34.7	225	88.6	162	63.8
56	4/27/82	10	330	129.9	89	35.0	228	89.8	171	67.3
57	4/27/82	3	310	122.1	85	33.5	206	81.1	185	72.8
58	4/27/82	8	306	120.5	87	34.3	218	85.8	165	65.0
53	4/27/82	3	290	114.2	84	33.1	207	81.5	182	71.7
Mean			296.1	116.6	87.7	34.5	200.0	78.7	167.6	66.0
±SD			19.3	7.6	3.3	1.3	16.3	6.4	10.3	4.1

Table 3. Body measurements of cow moose from Unit 22, 1981-82.

Moose No.	Date captured	Age	Total length cm	Total length in.	Hind Foot cm	Hind Foot in.	Girth cm	Girth in.
1	4/16/81	6	274	107.9	86	33.7	188	74.0
2	4/14/81	9	296	116.5	82	32.3	213	83.9
3	4/15/81	8	310	122.1	94	37.0	208	81.9
4	4/15/81	7	303	119.3	91	35.8	214	84.3
5	4/14/81	5	307	120.9	--	--	205	80.7
6	4/16/81	6	297	116.9	89	35.0	201	79.1
7	4/15/81	3	264	103.9	86	33.9	201	79.1
8	4/15/81	3	287	113.0	--	--	204	80.3
9	4/14/81	9	289	113.8	87	34.3	200	78.7
10	4/16/81	4	277	109.1	86	33.7	179	70.5
11	4/14/81	16	299	117.7	87	34.3	168	66.1
12	4/16/81	7	297	116.9	94	37.0	192	75.6
13	4/16/81	3	295	116.1	91	35.8	218	85.8
14	4/15/81	14	311	122.4	88	34.7	198	77.9
15	4/19/81	2	266	104.7	89	35.0	170	66.9
16	4/14/81	5	277	109.1	88	34.7	215	84.7
17	4/16/81	12	297	116.9	88	34.7	203	79.9
18	4/14/81	3	272	107.1	83	32.7	208	81.9
19	4/15/81	8	279	109.8	88	34.7	226	89.0
20	4/14/81	6	295	116.1	89	35.0	208	81.9
29	4/16/81	9	290	114.2	86	33.7	192	75.6
42	4/16/81	unk	279	109.8	89	35.0	190	74.8
60	4/27/82	7	330	129.9	88	34.7	210	82.3
Mean			290.9	114.5	88.0	34.7	200.5	78.9
±SD			16.0	6.3	2.9	1.2	14.6	5.7

Table 4. Comparison of body measurements[a] of Unit 22 (Seward Peninsula) moose with 5 populations of Alaskan moose.

Area in Alaska	Total length				Chest girth				Hind foot length			
	Pop. ranking	Mean cm	±SD	N	Pop. ranking	Mean cm	±SD	N	Pop. ranking	Mean cm	±SD	N
Moose Research Center (Feb, Mar, Apr)	6	283	9.1	254	6	180	11.1	252	5	79	1.9	246
GMU 15C (Apr 1975)	5	289	14.2	210	5	182	16.3	194	4	80	3.8	203
GMU 13 (Apr 1973)	3	296	10.9	115	4	191	14.3	105	3	80	2.9	79
GMU 9 (Apr 1977)	1	302	6.8	54	2	201	12.2	53	3	80	1.8	12
Copper River Delta (Mar 1974)	2	302	8.1	23	1	201	13.8	25	2	82	1.8	16
Seward Peninsula Cows (Apr 1981-82)	4	291	16.0	23	3	200	14.6	23	1	88	2.9	21
Seward Peninsula Bulls (Apr 1981-82)		296	19.3	27		200	16.3	26		88	3.3	23

[a] Measurements taken predominantly from cows.

Table 5. Percentages of moose in age classes 1-8+ that comprised annual harvests in Unit 22, 1973-83, compared to ages from radio-collared moose.

		Age in years								
Year	Sex	1	2	3	4	5	6	7	8+	Sample size
1973	Bulls	44	4	15	23	7	3	4	0	73
1974	Bulls	33	26	15	8	10	2	4	2	94
1975	Bulls	23	32	10	17	7	5	4	2	87
1976	Bulls	24	37	20	9	3	3	1	3	124
1977	Bulls	17	22	16	14	8	9	5	9	98
1978	Bulls	37	23	15	10	6	3	1	5	100
1979	Bulls	34	21	11	17	7	5	1	3	91
1980	Bulls	37	35	8	5	3	7	1	4	76
1981	Bulls	31	30	19	8	8	2	0	2	106
1982	Bulls	38	23	14	8	6	2	2	7	117
1983	Bulls	25	33	19	9	5	3	1	5	153
Total bulls 1973-1983		30	27	15	12	6	4	2	4	1119
Total cows[a] 1974-1983		23	20	14	10	7	5	5	16	457
Radio-collared moose 1981-1982		-[b]	9	26	9	6	11	9	30	46

[a] Cow data for each year are not shown because of small sample size; data from 1974-83 were combined for each age class and are presented in this table for comparison.

[b] Short yearlings not sampled.

Table 6. Condition-related blood values for Unit 22 moose during late winter 1981.

Visual collar No.	Radio serial No.	Sex	Age	PCV	Hb	TSP	P	Ca
1	8143	F	6	43.5	17.0	6.5	3.5	11.2
2	8126	F	9	45.0	18.6	6.2	4.3	10.4
3	8113	F	8	48.0	18.8	6.3	3.4	10.2
4	8130	F	7	39.5	15.0	6.3	2.4	11.2
5	8137	F	5	41.5	17.2	5.8	4.2	9.3
6	8115	F	6	36.5	17.0	6.0	3.9	11.6
7	8138	F	3	44.5	17.7	6.3	4.3	10.4
8	8104	F	3	50.0	18.2	6.7	4.5	12.1
9	8123	F	9	45.0	18.6	6.2	4.8	11.5
10	8128	F	4	38.5	16.0	6.2	3.0	11.7
11	8106	F	16	40.0	17.0	5.6	4.0	10.1
12	8124	F	7	48.0	18.3	5.9	3.7	10.7
13	8119	F	3	40.0	18.5	5.9	4.5	11.2
14	8112	F	14	44.0	17.2	5.9	3.1	11.0
15	8132	F	2	42.5	18.0	5.6	3.9	10.9
16	8110	F	5	38.0	16.8	6.0	4.3	10.1
17	8140	F	12	42.5	17.8	6.7	3.4	10.8
18	8136	F	3	34.0	17.0	6.1	5.0	9.7
19	8111	F	8	46.0	17.8	6.4	4.1	10.4
20	8118	F	6	39.5	14.6	6.5	4.0	10.9
22	8129	M	4	45.0	18.5	6.1	3.2	11.3
23	8117	M	7	50.0	18.0	6.9	5.8	11.2
24	8116	M	3	42.0	16.8	6.0	5.4	10.9
25	8139	M	3	43.0	18.0	5.8	3.7	11.8
26	8142	M	11	43.5	17.0	7.5	3.9	12.7
27	8141	M	4	40.0	17.0	5.9	4.7	10.0
29	8135	F	9	37.0	16.0	5.4	2.6	10.8
30	8109	M	unk	44.0	16.8	6.2	3.4	12.0
31	8131	M	5	46.5	17.2	6.9	3.4	11.5
32	8122	M	3	40.0	12.6	6.0	4.5	10.6
35	8121	M	2	47.0	19.5	5.8	4.4	10.8
36	8133	M	6	45.0	18.5	6.1	3.4	10.5
37	8125	M	3	39.0	16.8	6.0	3.1	10.1
38	8108	M	4	41.0	17.0	5.8	3.9	10.9
40	8120	M	8	45.0	17.8	6.6	4.2	10.5
42	8114	F	unk	46.5	18.8	6.9	3.9	12.3
$\overline{X}$ (all ages combined [N = 36])				42.7	17.3	6.2	3.9	10.9
$\pm$ SD				3.9	1.3	0.4	0.7	0.7
$\overline{X}$ (37+ mo., [N = 25])				42.6	17.3	6.3	3.9	10.8
$\pm$ SD				4.0	1.1	0.5	0.7	0.9

Table 7. Condition related blood parameters from 18 Alaskan moose populations during late winter/early spring season.[a]

Population		PCV (%)			Hb (g/dl)			TSP (g/dl)			P (mg/dl)			Ca (mg/dl)		
		$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N
Moose Research Center (inside pens)		41.0	5.0	37	16.8	2.1	38	6.9	0.6	42	4.3	1.6	42	9.8	1.3	42
Moose Research Center (outside pens)		41.8	5.2	38	16.5	1.9	39	6.8	0.6	52	3.8	1.1	52	10.0	0.7	52
GMU 1	1978	36.6	6.1	14	14.2	2.3	14	6.4	0.4	14	5.0	0.9	14	9.8	0.5	14
GMU 5	1978	40.4	3.4	36	16.6	1.4	36	7.5	0.3	35	3.7	1.0	35	11.0	0.5	35
GMU 6	1974	53.5	3.8	32	19.9	0.3	32	7.3	0.5	30	5.3	0.6	30	10.5	0.7	30
GMU 9	1977	39.0	5.4	56	16.4	1.3	54	7.8	0.4	57	4.4	0.6	57	10.8	0.4	57
GMU 13	1975	49.2	3.8	55	19.7	0.7	55	7.4	0.4	53	5.6	0.9	53	10.8	0.8	53
GMU 13	1977							7.2	0.5	29	4.4	0.9	29	11.4	0.8	29
GMU 13	1979	40.9	3.6	10	16.8	1.6	10	5.6	0.6	12	4.8	0.8	12	9.4	1.0	12
GMU 13	1980	43.0	5.2	23	17.8	1.2	23	6.8	0.5	27	5.1	1.3	27	10.2	0.5	27
GMU 13	1981	43.8	4.3	9	17.8	1.7	9	6.7	0.5	7	5.2	1.2	7	10.5	0.6	7
GMU 14	1974	35.8	10.2	21	13.5	3.0	20	6.8	0.4	30	4.7	1.3	30	10.3	0.7	30
GMU 15	1970							6.7	0.5	24	4.4	0.9	24	11.1	0.6	24
GMU 15	1971							6.6	0.4	40	3.5	0.9	40	10.2	0.4	40
GMU 15	1975	46.4	3.0	25	18.9	1.3	25	6.9	0.7	24	4.8	1.1	24	9.9	0.9	24
GMU 15	1977	36.5	4.4	12	13.2	2.3	12	6.2	0.3	13	3.9	1.4	13	10.5	1.1	13
GMU 20	1975							6.9	0.5	12	4.7	1.1	19	8.9	0.6	12
GMU 22	1981	42.6	4.0	25	17.3	1.1	25	6.3	0.5	25	3.9	0.7	25	10.8	0.9	26
All pop. combined		43.6	6.9	406	17.3	2.6	406	6.9	0.6	544	4.6	1.3	544	10.4	1.0	544

[a] After Franzmann and Schwartz (1983).

Table 8. Rank of Alaskan moose populations based on condition-related blood parameters.[a]

Rank	PCV (%)	Hb (g/dl)	TSP (g/dl)	P (mg/dl)	Ca (mg/dl)
1	GMU 6[b] (1974)[c]	GMU 6 (1974)	GMU 13 (1975)	GMU 13 (1975)	GMU 13 (1977)
2	GMU 13 (1975)	GMU 13 (1975)	GMU 5 (1978)	GMU 6 (1974)	GMU 15 (1970)
3	GMU 15 (1975)	GMU 15 (1975)	GMU 13 (1975)	GMU 13 (1981)	GMU 5 (1978)
4	GMU 13 (1981)[d]	GMU 13 (1981)	GMU 6 (1974)	GMU 13 (1980)	GMU 13 (1975)
5	GMU 13 (1980)	GMU 13 (1980)	GMU 13 (1977)	GMU 1 (1978)	GMU 22 (1981)[e]
6	GMU 22 (1981)[e]	GMU 22 (1981)[e]	GMU 15 (1975)	GMU 15 (1975)	GMU 9 (1977)
7	MRC[f] (outside)	GMU 13 (1979)	MRC (in pens)	GMU 13 (1979)	GMU 6 (1974)
8	MRC (in pens)	MRC (in pens)	GMU 20 (1975)	GMU 20 (1975)	GMU 13 (1981)
9	GMU 13 (1979)	GMU 5 (1978)	MRC (in pens)	GMU 14 (1974)	GMU 15 (1977)
10	GMU 5 (1978)	MRC (outside)	GMU 13 (1980)	GMU 9 (1977)	GMU 14 (1974)
11	GMU 9 (1977)	GMU 9 (1977)	GMU 14 (1974)	GMU 15 (1970)	GMU 15 (1971)
12	GMU 1 (1978)	GMU 1 (1978)	GMU 13 (1981)	GMU 13 (1977)	GMU 13 (1980)
13	GMU 15 (1977)	GMU 14 (1974)	GMU 15 (1970)	MRC (in pens)	MRC (outside)
14	GMU 14 (1974)	GMU 15 (1977)	GMU 15 (1971)	GMU 22 (1981)[e]	GMU 15 (1975)
15			GMU 1 (1978)	GMU 15 (1977)	MRC (in pens)
16			GMU 22 (1981)[e]	MRC (outside)	GMU 1 (1978)
17			GMU 15 (1977)	GMU 5 (1978)	GMU 13 (1979)
18			GMU 13 (1978)	GMU 15 (1971)	GMU 20 (1975)

[a] Table per Franzmann and Schwartz (1983).
[b] GMU = Game Management Unit.
[c] Year of collection.
[d] Double line represents combined populations' mean value.
[e] Shows Unit 22 ranking with other Alaskan populations.
[f] MRC = Moose Research Center.

Table 9. Comparison of PCV and Hb blood values of Unit 22 moose from 1981 and 1983.

	Packed cell volume (PCV %) 1983 Samples						Hemoglobin (Hb g/dl) 1983 Samples					
Moose No.	Vial 1	Vial 2	Vial 3	Vial 4	Mean vials 1-4	1981 Mean	Vial 1	Vial 2	Vial 3	Vial 4	Mean vials 1-4	1981 Mean
3	34.5	34.0	35.0	34.5	34.5	48.0	13.9	13.5	13.7	12.8	13.5	18.8
5	35.0	35.0	35.0	36.0	35.3	41.5	13.2	13.3	14.6	13.6	13.7	17.2
7	38.5	37.5	39.5	39.0	38.6	44.5	14.8	14.7	14.9	14.5	14.7	17.7
9	41.0	41.5	42.0	41.5	41.5	45.0	16.2	16.3	16.2	16.1	16.2	18.6
16	41.0	41.0	42.5	42.5	41.8	38.0	15.3	15.6	16.6	16.1	15.9	16.8
18	40.0	40.5	40.0	40.5	40.3	34.0	15.6	15.2	14.8	15.7	15.3	17.0
20	36.5	37.0	36.0	36.0	36.3	39.5	14.3	14.5	14.4	14.0	14.3	14.6
35	38.0	38.0	38.5	37.5	38.0	47.0	14.7	14.4	14.1	14.3	14.4	19.5
37	--	--	37.5	38.0	37.8	39.0	--	--	14.2	14.8	14.5	16.8
40	39.5	40.0	41.0	37.5	39.5	45.0	14.8	15.1	15.2	14.2	14.8	17.8
$\bar{X}$					38.4	42.2					14.5	17.5
SD for paired differences.						5.78						1.618

Table 10. Comparison of PCV and Hb blood values of Unit 22 moose from 1981 and 1984.

	Packed cell volume (PCV %) 1984 Samples						Hemoglobin (Hb g/dl) 1984 Samples					
Moose No.	Vial 1	Vial 2	Vial 3	Vial 4	Mean vials 1-4	1981 Mean	Vial 1	Vial 2	Vial 3	Vial 4	Mean vials 1-4	1981 Mean
5	42.7	41.9	43.8	42.2	42.7	41.5	15.3	15.2	15.4	15.6	15.4	17.2
7	40.2	39.6	40.3	41.0	40.3	44.5	14.8	14.3	14.8	14.9	14.7	17.7
9	--	--	43.4	45.4	44.4	45.0	--	--	16.4	16.1	16.3	18.6
16	--[a]	--	--[a]	34.1	34.1	38.0	--[a]	--	--	12.1	12.1	16.8
18	40.9	40.2	40.5	40.3	40.5	34.0	14.9	14.7	14.9	14.9	14.9	17.0
19	--[b]	--	32.4	33.9	33.4	46.0	--[b]	--	11.9	12.4	12.2	17.8
26	38.5	38.9	38.6	38.3	38.6	43.5	14.0	14.4	14.3	14.0	14.2	17.0
35	--	--	41.7	41.8	41.8	47.0	--	--	15.3	15.2	15.3	19.5
40	42.4	42.7	42.6	43.0	42.7	45.0	15.8	15.4	15.7	15.7	15.7	17.8
40	39.5	40.0	41.0	37.5	39.5	45.0	14.8	15.1	15.2	14.2	14.8	17.8
$\bar{X}$ For 1984 samples excluding moose Nos. 16 and 19 (poor samples)					41.5	--					15.2	--
$\bar{X}$ All samples combined					39.8	42.2					14.5	17.5
SD for paired differences.						5.21						1.34

[a] One usable vial, but poor sample.
[b] Two usable vials, but poor samples.

Table 11. Mineral element levels (ppm) in hair from Unit 22 moose, April 1981.

Radio serial no.	Zn	Cu	K	Co	Fe	Pb	Ca	Mg	Na	Cd	Mn	Cr	Mo	Se	Al
8104	75.1	3.2	583.0	0.4	63.1	7.6	308.0	57.0	808.0	1.3	1.3	0.3	0.4	1.8	2.6
8105	80.6	6.3	427.0	0.4	52.6	4.3	281.0	68.0	593.0	1.4	1.6	0.3	0.4	1.3	1.8
8106	47.5	2.9	509.0	0.4	73.5	8.8	316.0	71.0	962.0	1.5	1.2	0.6	0.6	1.2	1.6
8107	59.6	7.2	368.0	0.4	74.3	7.2	408.0	60.5	671.0	0.2	1.2	0.4	0.6	1.6	4.4
8108	46.3	8.5	477.0	0.6	50.8	2.0	272.0	67.0	715.5	0.8	2.0	0.4	0.4	1.2	2.8
8109	83.2	8.6	762.0	0.6	56.5	2.4	463.0	42.0	762.0	0.6	2.3	0.3	0.8	1.2	1.2
8110	78.8	5.5	580.5	0.5	61.2	3.3	429.0	78.5	639.0	0.3	0.6	0.8	0.7	0.8	1.8
8111	92.7	7.3	440.5	0.6	39.9	4.9	381.5	48.0	792.5	0.8	2.0	0.3	0.6	1.3	1.7
8112	72.2	7.8	609.5	0.5	60.8	4.2	183.0	56.0	347.5	0.6	1.3	0.6	1.2	1.9	1.6
8113	64.6	8.2	438.0	0.3	53.3	7.2	250.0	80.0	738.5	0.6	1.2	0.3	0.5	0.2	1.3
8114	68.3	2.4	704.5	0.5	52.4	9.6	365.5	53.5	1029.5	0.4	0.3	0.8	0.4	1.6	1.9
8115	62.2	6.9	398.5	0.7	60.9	8.8	430.5	63.0	726.0	0.5	1.0	0.2	0.4	0.4	1.4
8116	80.6	11.3	482.0	0.3	73.6	2.3	291.5	49.5	465.5	0.2	2.0	0.9	0.4	1.3	6.2
8117	73.8	3.9	468.0	0.3	32.5	3.9	249.5	59.0	611.0	0.6	1.0	0.6	1.0	1.8	1.2
8118	76.3	9.4	465.0	0.3	78.4	4.3	346.5	58.5	526.5	0.3	1.0	0.6	0.5	1.6	1.6
8119	82.2	2.3	603.0	0.4	62.5	4.0	364.5	74.5	1016.0	0.7	1.1	0.6	0.2	1.2	4.8
8120	83.6	5.8	443.6	0.4	48.5	7.6	327.5	60.5	443.5	0.8	1.2	.5	0.8	0.8	2.6
8121	90.9	3.5	783.5	0.3	65.2	1.1	287.5	68.0	548.5	0.8	1.6	0.6	0.8	0.6	1.4
8122	57.3	5.3	439.5	0.8	73.0	3.5	416.5	63.0	1026.0	0.6	1.3	0.7	0.6	1.0	1.6
8123	68.0	5.0	482.5	0.6	107.9	2.6	429.5	42.0	692.0	0.6	1.2	1.2	0.4	0.4	1.3
8124	47.9	5.6	429.0	0.2	80.7	9.3	399.0	59.0	684.5	0.6	2.3	0.3	0.4	2.8	1.8
8125	48.1	6.9	652.0	0.2	69.3	4.0	439.5	68.0	711.5	0.6	2.0	0.8	0.4	2.2	1.6
8126	96.7	10.0	568.0	0.2	96.7	3.3	502.0	36.0	612.0	0.6	2.6	0.4	1.0	2.6	2.0
8127	21.3	3.8	537.0	0.2	48.3	3.3	372.0	93.5	908.0	0.6	2.2	0.8	1.2	2.2	2.2
8128	93.8	8.6	489.0	0.1	34.8	1.4	268.5	73.0	537.5	0.3	2.0	0.9	0.6	1.6	5.8
8129	68.5	7.5	392.0	0.3	83.2	8.6	329.5	92.0	451.0	1.0	2.1	0.6	0.8	1.6	5.3
8130	54.0	7.3	421.0	0.3	90.9	4.5	262.5	83.0	596.0	0.8	0.8	0.8	0.8	1.8	3.5
8131	61.7	2.2	360.0	0.3	46.6	2.8	306.5	87.5	1008.5	1.2	1.4	0.6	1.2	2.0	1.9
8132	30.6	6.6	602.5	0.2	55.4	7.5	314.5	46.0	949.0	0.6	1.3	0.5	1.2	2.3	2.2
8133	83.4	3.8	490.5	0.3	46.6	10.5	338.0	55.5	562.0	0.2	1.5	1.0	0.6	0.5	1.6
8134	72.6	8.0	400.0	0.3	74.8	7.2	308.5	69.0	581.0	0.8	2.2	0.6	1.2	0.4	2.8
8135	68.9	7.5	473.5	0.3	81.5	7.3	275.0	82.0	508.5	0.2	3.0	0.2	0.8	0.6	2.5
8136	39.6	9.6	480.5	0.2	73.2	3.8	311.0	61.5	396.5	0.2	2.8	0.3	0.8	0.2	1.5
8137	51.5	10.1	475.0	0.3	70.1	8.2	393.5	46.5	1002.5	0.4	2.6	0.8	1.2	1.8	1.6
8138	65.4	14.3	347.5	0.3	49.7	8.8	262.0	53.5	445.5	0.5	1.8	0.5	1.0	1.3	3.3
8139	63.3	11.2	458.0	0.2	53.8	2.3	367.5	45.5	512.5	0.5	1.3	0.5	0.6	0.6	1.5
8140	68.2	9.6	726.5	0.3	57.4	3.0	357.5	90.0	1163.5	0.6	2.0	0.3	1.2	1.6	2.4
8141	65.4	8.0	538.0	0.4	63.2	4.5	293.0	72.0	926.0	0.3	1.1	0.8	0.8	1.1	2.1
Mean	67.0	6.89	508.0	0.37	64.0	5.3	340.0	64.0	707.0	0.62	1.62	0.57	0.72	1.33	2.38
± SD	17.2	2.8	110.0	0.16	17.0	2.7	70.0	15.0	228.0	0.33	0.63	0.24	0.30	0.67	1.30

Table 12. Comparison of Unit 22 moose hair mineral element levels with mineral element levels (ppm) in Alaska moose hair by condition class.[a]

Condition class	Zinc			Copper			Cobalt			Iron			Potassium			Lead		
	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N
4	77	19	14	5.3	2.6	14	0.8	0.7	14	48	12	14	618	373	14	1.7	2.4	14
5	82	22	79	4.8	3.1	79	0.7	0.6	79	52	18	79	685	359	79	4.3	3.6	79
6	82	23	215	7.1	5.1	215	0.8	0.9	215	50	18	215	884	636	215	5.9	5.5	215
7	83	24	235	8.0	4.2	235	1.1	1.0	235	53	20	235	1079	740	235	6.4	5.2	235
8	84	24	109	10.6	4.4	109	1.2	1.0	109	55	23	109	1235	734	109	6.8	5.3	109
9	94	25	12	10.4	3.9	12	1.3	1.0	12	66	46	12	1157	1063	12	5.5	4.6	12
Unit 22 totals	67	17.2	38	6.9	2.8	38	0.37	0.16	38	63.6	17	38	508	110	38	5.3	2.7	38
	Ranks below class 4			Ranks between classes 5 & 6			Ranks below class 4			Ranks between classes 8 & 9			Ranks below class 4			Ranks between classes 5 & 6		

[a] Condition class values follow Franzmann and Schwartz (1983).

Table 13. Movement summary Unit 22 bulls, April 1981-January 1984.

Visual collar no.	Mobility class[a]	No. of observs.	Mean distance traveled between sightings (mean distance/month) km	Mean distance traveled between sightings (mean distance/month) mi	Closest dist. returned to pt. of capture (winter range fidelity) km	Closest dist. returned to pt. of capture (winter range fidelity) mi	Farthest distance from point of capture km	Farthest distance from point of capture mi	Approximate distance between summer & winter range km	Approximate distance between summer & winter range mi	Longest dist. between consecutive observations km	Longest dist. between consecutive observations mi
22	S	20	5.6	3.7	1.6	1.0	9.6	5.5	8.0	5.0	11.3	7.2
34	S	17	8.6	5.3	4.8	3.0	2.5	14.1	16.1	10.0	20.9	12.9
36	S	18	8.0	5.0	1.6	1.0	16.1	10.3	8.0	5.0	22.5	14.0
26	I	18	6.9	4.3	0.6	0.4	25.1	15.6	16.1	10.0	22.9	14.2
40	I	19	9.1	5.7	1.6	1.0	25.7	15.6	19.3	12.0	26.4	16.4
50	I	11	9.6	6.0	4.5	2.8	24.1	15.0	16.1	10.0	28.7	17.8
51	I	12	9.8	6.1	6.4	4.0	25.7	16.0	19.3	12.0	22.3	13.8
21	H	16	16.1	10.0	16.7	10.4	9.5	37.0	53.1	33.0	57.9	36.0
23	H	11	22.2	13.7	9.8	6.1	4.7	34.0	32.2	20.0	56.3	35.2
27	H	12	19.9	11.9	4.3	2.7	6.7	28.6	32.2	20.0	55.1	28.2
29	H	10	20.5	12.2	1.6	1.0	58.2	36.2	56.3	35.0	57.9	35.8
30	H	16	19.6	12.2	4.8	3.3	68.4	42.5	56.3	35.0	64.0	39.8
35[b]	H	19	25.8	16.1	23.5	14.6	78.8	49.0	72.4	45.0	62.4	38.8
37	H	17	11.9	7.4	16.9	10.5	41.4	25.8	40.2	25.0	25.8	16.0
53[b]	H	10	19.3	12.0	56.5	35.1	66.6	41.4	56.3	35.0	42.5	26.4
56	H	11	15.1	9.4	10.3	6.4	46.7	29.0	40.2	25.0	30.9	19.2
58	H	10	18.9	11.8	14.5	9.0	69.8	43.4	32.2	20.0	54.3	33.8
$\bar{X}$ All S & I's			8.4	5.2	3.0	1.9	4.9	9.3	14.7	9.1	22.1	13.7
$\bar{X}$ All H's			18.8	11.7	15.9	9.9	59.1	36.7	47.1	30.0	50.7	31.5
$\bar{X}$ All S, I, & H's			14.5	9.0	10.6	6.6	43.5	27.0	33.8	21.0	39.2	24.4
$\bar{X}$ All bulls and cows (Tables 13 and 14 combined)			15.9	9.9	7.6	4.7	44.6	27.7	33.9	21.1	43.3	25.9

[a] S=Sedentary; I=Intermediate; H=Highly migratory.
[b] Used alternate winter range most of the year.

Table 14. Movement summary Unit 22 cows, April 1981-January 1984.

Visual collar no.	Mobility class[a]	No. of observs.	Mean distance traveled between sightings (mean distance/month)		Closest dist. returned to pt. of capture (winter range fidelity)		Farthest distance from point of capture		Approximate distance between summer & winter range		Longest dist. between consecutive observations	
			km	mi	km	mi	km	mi	km	mi	km	mi
4	S	21	6.6	4.1	1.0	0.6	11.6	7.2	12.9	8.0	16.3	10.1
13	S	19	7.2	4.5	1.9	1.2	15.8	9.8	6.4	4.0	17.9	11.1
14	S	22	10.0	6.0	0.8	0.5	20.6	12.8	12.9	8.0	25.7	16.0
17	S	17	33.8	24.8	3.4	2.1	23.2	14.4	8.0	5.0	22.2	13.8
1	I	21	14.9	9.3	0.9	0.6	29.1	18.1	24.1	15.0	71.1	44.3
6	I	19	12.1	7.5	2.6	1.6	20.9	13.0	6.4	4.0	26.7	16.6
16	I	21	13.8	8.7	2.1	1.3	26.2	16.3	8.0	5.0	25.3	15.7
19	I	18	13.4	8.3	0.2	0.1	27.4	17.0	20.9	13.0	31.4	19.5
2	H	11	13.0	8.0	30.7	19.1	42.6	26.5	30.6	19.0	37.0	23.0
3	H	17	12.5	7.7	0.8	0.5	35.9	22.3	19.3	12.0	46.7	29.0
5	H	21	14.4	8.9	9.0	5.6	52.8	32.8	40.2	25.0	47.0	29.2
7	H	18	20.4	13.6	1.3	0.8	70.0	43.5	64.3	40.0	65.8	41.0
8	H	18	19.5	12.1	9.8	6.1	64.4	40.0	56.3	35.0	64.4	40.0
9	H	18	16.7	10.4	0.2	0.1	56.0	34.8	40.2	25.0	54.4	33.8
10	H	16	18.6	11.6	10.9	6.8	79.2	49.2	64.3	40.0	72.4	45.0
11	H	9	35.0	21.8	8.0	5.0	96.5	60.0	80.4	50.0	96.5	60.0
12	H	13	17.5	10.9	4.2	2.6	48.3	30.0	40.2	25.0	48.3	30.0
15	H	13	19.1	11.8	4.3	2.7	68.4	42.5	48.3	30.0	47.6	29.6
18	H	12	30.1	18.7	0.5	0.3	79.0	49.1	56.3	35.0	77.2	48.0
20	H	19	12.8	7.9	6.8	4.2	42.2	26.2	40.2	25.0	40.4	25.1
	$\bar{X}$ All S & I's		14.0	9.2	1.6	1.0	21.9	13.6	12.5	7.8	29.6	18.4
	$\bar{X}$ All H's		19.1	12.0	7.2	4.5	61.3	38.1	48.4	30.0	58.1	36.1
	$\bar{X}$ All S, I, & H's		17.1	10.8	5.0	3.1	45.4	28.3	34.0	21.1	46.7	29.0
	$\bar{X}$ All bulls and cows (Tables 13 and 14 combined)		15.9	9.9	7.6	4.7	44.6	27.7	33.9	21.1	43.3	25.9

[a] S=Sedentary; I=Intermediate; H=Highly migratory.

Table 15. Seasonal and annual home ranges[a] of Unit 22 bulls and cows, April 1981-January 1984.

Bulls

Collar no.	No. locations	Summer km²	Summer mi²	Winter km²	Winter mi²	Total km²	Total mi²
21	16	47	18	300	116	554	214
22	20	83	32	36	14	91	35
23	11	609	235	453	175	1323	511
26	18	114	44	52	20	233	90
27	12	407	157	236	91	1243	480
29	10	96	37	132	51	901	348
30	16	1323	511	363	140	1917	740
34	17	44	17	70	27	176	68
35	19	655	253	393	538	1932	746
36	18	75	29	223	86	319	123
37	17	228	88	212	82	531	205
40	19	111	43	67	26	202	78
50	11	60	23	23	9	246	95
51	12	106	41	28	11	236	91
53	10	350	135	513	198	899	347
56	11	443	171	104	40	583	225
58	10	487	188	329	127	1331	514
N=17							
X̄		308	119	267	103	749	289
Range km² =		44-1323		23-1393		91-1932	
Range mi² =		17-511		9-538		35-746	

Cows

Collar no.	No. locations	Summer km²	Summer mi²	Winter km²	Winter mi²	Total km²	Total mi²
1	21	114	44	272	105	401	155
2	11	171	66	44	17	236	91
3	17	378	146	142	55	378	146
4	21	91	35	65	25	145	56
5	21	52	20	521	201	650	251
6	19	357	138	179	69	502	194
7	18	684	264	373	144	1300	502
8	18	49	19	205	79	932	360
9	18	47	18	36	14	622	240
10	16	85	33	376	145	821	317
11	9	130	50	75	29	992	383
12	13	41	16	383	148	645	249
13	19	98	38	62	24	251	97
14	22	111	43	78	30	197	76
15	13	339	131	39	15	831	321
16	21	264	102	21	8	298	115
17	17	150	58	158	61	350	135
18	12	298	115	412	159	1557	601
19	18	557	215	334	129	593	229
20	19	199	77	223	86	440	170
N=20							
X̄		210	81	199	77	606	234
Range km² =		41-684		21-521		145-1557	
Range mi² =		16-264		8-201		56-601	

[a] Data rounded to nearest whole numbers.

Table 16. Seasonal and annual home ranges[a] of sedentary, intermediate, and migratory moose in Unit 22, April 1981-January 1984.

Sedentary

Moose no.	Summer km²	Summer mi²	Winter km²	Winter mi²	Total km²	Total mi²
4	91	35	64	25	145	56
13	98	38	62	24	251	97
14	111	43	78	30	197	76
17	150	58	158	61	350	135
22	83	32	36	14	91	35
34	44	17	70	27	176	68
36	75	29	223	86	319	123
N = 7						
$\bar{X}$	93	36	98	39	218	84
km²	44-150		36-223		91-350	
mi²	17-58		14-86		35-135	

Intermediate

Moose no.	Summer km²	Summer mi²	Winter km²	Winter mi²	Total km²	Total mi²
1	114	44	272	105	401	155
6	357	138	179	69	502	294
16	264	102	21	8	298	115
19	559	215	334	129	593	229
26	114	44	52	20	233	90
40	111	43	67	26	202	78
50	60	23	23	9	246	95
51	106	41	28	11	236	91
N = 8						
$\bar{X}$	210	81	122	47	339	131
km²	60-559		21-334		202-593	
mi²	23-215		8-129		78-229	

Migratory

Moose no.	Summer km²	Summer mi²	Winter km²	Winter mi²	Total km²	Total mi²
2	171	66	44	17	236	91
3	378	146	142	55	378	146
5	52	20	521	201	650	251
7	684	264	373	144	1300	502
8	49	19	205	79	932	360
9	47	18	36	14	622	240
10	85	33	376	145	821	317
11	130	50	75	29	992	383
12	41	16	383	148	632	244
13	339	131	39	15	831	321
18	298	115	412	159	1557	601
20	199	77	223	26	440	170
21	47	18	300	116	554	214
23	609	235	453	175	1323	511
27	407	157	236	91	1243	480
29	96	37	132	51	901	348
30	1323	511	363	140	1917	740
35	655	253	1393	538	1932	746
37	228	88	212	82	531	205
53	350	135	513	198	899	347
56	443	171	104	40	583	225
58	487	188	329	127	1331	514
N = 22						
$\bar{X}$	324	125	311	120	938	362
km²	41-1323		36-1393		236-1932	
mi²	16-511		14-538		91-746	

[a] Data rounded to whole numbers.

Table 17. Reproductive history of radio-collared moose, April 1981-January 1984.

Collar No.	Type[a]	Age (yr)	1981-82 Apr	1981-82 May June	1981-82 Aug Sept	1981-82 Nov Dec	1981-82 Apr	Recruit. after 2 years	1982-83 May June	1982-83 Aug Sept	1982-83 Nov Dec	1982-83 Apr	Recruit. after 3 years	1983-84 May June	1983-84 Aug Sept	1983-84 Nov Dec	1983-84 Jan	Recruit. after 4 years
1	I	6	2 yrlgs	alone			0	2 yrlgs	1 calf			1 yrlg	3 yrlgs	1 calf	alone		0	3 yrlgs
2	H	9	2 yrlgs	2 calves	1 calf		1 yrlg	3 yrlgs	2 calves	[cow died 6/24/82]xxx		3[b] yrlgs	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx					3[b] yrlgs
3	H	8	alone	2 calves		1 calf	1 yrlg	1 yrlg	1 calf			1 yrlg	2 yrlgs	[cow lost radio 6/6/83]xxxxxx				2[b] yrlgs
4	S	4	1 yrlg	2 calves	alone		0	1 yrlg	2 calves	alone		0	1 yrlg	2 calves				3 yrlgs
5	H	5	2 yrlgs	1 calf			1 yrlg	3 yrlgs	2 calves	1 calf		1 yrlg	4 yrlgs	alone			0	4 yrlgs
6	I	6	2 yrlgs	2 calves			2 yrlgs	4 yrlgs	2 calves			2 yrlgs	6 yrlgs	alone			0	6 yrlgs
7	H	3	alone	1 calf			0	0	alone			0	0	alone			0	0
8	H	3	alone	1 calf	alone		0	0	1 calf			1 yrlg	1 yrlg	1 yrlg			0	1 yrlg
9	H	9	2 yrlgs	1 calf			1 yrlg	3 yrlgs	1 calf			1 yrlg	4 yrlgs	alone			0	4 yrlgs
10	H	4	1 yrlg	alone			0	1 yrlg	2 calves			2 yrlgs	3 yrlgs	1 calf				4 yrlgs
11	H	16	alone	alone	1 calf	alone	0	0	[cow died 6/21/82]xxxxxxxxx				0	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				0[b]
12	H	7	1 yrlg	2 calves			2 yrlgs	3 yrlgs	2 calves	1 calf		1 yrlg	3[b] yrlgs	[cow killed 12/17/82]xxxxxxxx				3[b] yrlgs

Table 17. Continued.

Collar No.	Type[a]	Age (yr)	1981-82 Apr	May June	Aug Sept	Nov Dec	Apr	Recruit. after 2 years	1982-83 May June	Aug Sept	Nov Dec	Apr	Recruit. after 3 years	1983-84 May June	Aug Sept	Nov Dec	Jan	Recruit. after 4 years
13	S	3	1 yrlg	2 calves		1 calf	1 yrlg	2 yrlgs	alone			0	2 yrlgs	2 calves				4 yrlgs
14	S	14	1 yrlg	2 calves			2 yrlgs	3 yrlgs	2 calves	1 calf		1 yrlg	4 yrlg	2 calves	alone			4 yrlgs
15	H	2	11 yrlg	alone			0	1 yrlg	1 calf			1 yrlg	2	alone				2 yrlgs
16	I	5	1 yrlg			alone	0	1 yrlg	1 calf			1 yrlg	2 yrlgs	alone				2 yrlgs
17	S	12	alone	alone	1 calf		1 yrlg	1 yrlg	1		alone	0	1 yrlg	[cow died 05/84 xxxxxxxxxxx				1[b] yrlgs
18	H	3	alone				0	0	alone			0	0	[radio failure 06/84? xxxxxx				0
19	I	8	alone				0	0	1 calf	alone		0	0	2 calves	1 calf			1 yrlg
20	H	6	1 yrlg	2 calves	alone		0	1 yrlg	2 calves	1 calf		1	2 yrlgs	alone				2 yrlgs
29	H	9	alone	2 calves			2	2 yrlg	1 calf	x[cow diedxxxxxxxxx 7/10/82]			2[b] yrlgs	xxxxxxxxxxxxxxxxxxxxxxxxxxxxx				2[b] yrlgs
42	H	unk	1 yrlg	2 calves	1 calf			2 yrlgs	x[lost radio 01/82]xxxxx				2[b] yrlgs	xxxxxxxxxxxxxxxxxxxxxxxxxxxxx				2[b] yrlgs
Totals		19 yrlgs from 22 cows		26 calves from 22 cows		17 calves left alive	15 yrlgs	34 yrlgs from 22 cows	24 calves from 20 cows		14 calves left alive	13 yrlgs	47 yrlgs	11 calves from 14 cows		6 calves left alive		53
		87 yrlg: 100 cows		118 calves: 100 cows		77: 100	68: 100		120 calves: 100 cows		78: 100	76: 100		79 calves: 100 cows		55: 100		

[a] Type of migration status: S = Sedentary, I = Intermediate, H = Highly migratory.
[b] Yearling recruitment figure is biased because cow died or lost radio during study.

Table 18. Moose calf productivity in the Agiapuk and Kuzitrin drainages from 1971-83 as determined from aerial surveys during October-November.

Year	Agiapuk drainage				Kuzitrin drainage			
	No.cows (2+) w/calves	Total cows	% Cows/w calves	Calves: 100 cows	No.Cows (2+) w/calves	Total cows	% Cows/w calves	Calves: 100 cows
1971					26	30	87	107
1973	12	25	48	60	18	35	51	54
1974	3	4	75	125	99	158	63	75
1975	2	6	33	68	10	15	67	73
1976	44	72	61	64	52	86	60	63
1979	57	120	48	58	102	202	50	62
1980	17	38	45	58	53	129	41	48
1981	30	54	56	69	40	82	49	71
1982	31	79	39	48	73	237	31	35
1983	27	60	45	57	66	185	36	45

Appendix A. Group composition and movements of moose No. 1 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 6

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/2 yrlgs[a]	--	--	--	--
2	5/27/81	w/2 yrlgs/1 cow	22.5	13.5	21.5	13.5
3	6/09/81	alone	29.1	18.1	7.4	4.6
4	9/16/81	4 bulls/9 cows	28.8	17.9	1.8	1.1
5	11/06/81	alone	21.1	13.1	10.9	6.8
6	2/09/82	alone	14.5	9.6	36.0	22.4
7	3/11/82	1 adult	10.3	6.4	24.9	15.5
8	4/20/82	w/2 calves	2.3	1.4	10.9	6.8
9	5/07/82	6 adults	7.6	4.7	5.5	3.4
10	6/16/82	w/1 calf	4.7	2.9	3.5	2.2
11	6/30/82	w/1 calf	15.8	9.8	12.1	7.5
12	7/18/82	w/1 calf	20.9	13.0	5.1	3.2
13	10/12/82	w/1 calf/1 cow&calf	25.0	15.5	15.9	9.9
14	2/16/83	w/1 calf	15.3	9.5	71.1	44.3
15	4/26/83	w/1 yrlg	0.9	0.6	15.1	9.4
16	6/06/83	w/1 calf	21.4	13.3	21.4	13.3
17	6/28/83	alone	18.2	11.3	4.8	3.0
18	7/13/83	not sighted	25.8	16.0	9.7	6.0
19	8/30/83	6 cows	19.0	11.8	8.8	5.5
20	12/02/83	alone	16.0	10.0	10.1	6.3
21	1/30/84	3 adults	14.5	9.0	1.9	1.2
Totals			333.7	292.9	298.4	185.9
Mean distance between sightings			16.7	14.6	14.9	9.3

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 2 by individual location, April 1981-June 1982.

Sex Female Age (April 1981) 10

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	w/2 yrlgs[a]	--	--	--	--
2	5/26/81	w/2 yrlgs	37.0	23.0	37.0	23.0
3	6/09/81	w/2 calves	31.1	19.3	6.4	4.0
4	9/17/81	w/1 calf/50" bull	41.7	25.9	14.5	8.5
5	11/20/81	w/1 calf	42.6	26.5	17.5	10.9
6	2/09/82	not sighted	37.2	23.1	5.6	3.5
7	3/15/82	w/1 calf	39.3	24.4	2.3	1.4
8	4/09/82	w/1 yrlg	39.6	24.6	3.9	2.4
9	5/17/82	w/1 yrlg	39.3	24.4	4.5	2.8
10	6/15/82	w/2 calves	37.0	23.0	33.4	20.8
11	6/24/82	moose dead; probably killed by predator	30.7	19.1	4.8	3.0
Totals			375.5	233.3	129.9	80.3
Mean distance between sightings			37.6	23.3	13.0	8.0

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 3 by individual location, April 1981-June 1983.

Sex Female Age (April 1981) 8

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	Distance traveled: From point of capture mi	Distance traveled: From last sighting km	Distance traveled: From last sighting mi
1	4/22/81	alone	--	--	--	--
2	5/26/81	alone	14.5	9.0	14.5	9.0
3	6/09/81	w/2 calves	17.7	11.0	3.2	2.3
4	8/06/81	w/2 calves	12.8	8.0	9.6	5.5
5	11/19/81	w/1 calf	1.6	1.0	13.5	8.4
6	1/27/82	alone	16.1	10.0	17.7	11.0
7	3/02/82	w/1 calf	3.9	2.4	13.8	8.6
8	4/09/82	w/1 yrlg[a]/11 adults (#11 & #27)	0.8	0.5	3.9	2.4
9	5/07/82	5 adults	0.8	0.5	--	--
10	6/16/82	w/1 calf	19.3	12.0	18.5	11.5
11	6/30/82	not sighted	19.3	12.0	--	--
12	8/03/82	w/1 calf	20.6	12.8	2.0	1.2
13	10/12/82	w/1 calf	35.9	22.3	46.7	29.0
14	12/01/82	w/1 calf	3.9	2.4	32.2	20.0
15	2/16/83	w/1 calf	16.9	10.5	17.3	10.7
16	4/13/83	w/1 yrlg	15.9	9.9	1.5	0.9
17	6/06/83	moose lost collar	11.3	7.0	5.2	3.2
Totals			211.3	131.3	199.6	123.7
Mean distance between sightings			13.2	8.2	12.5	7.7

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 4 by individual location, April 1981-January 1984

Sex Female Age (April 1981) 7

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	5/27/81	w/2 calves	8.0	5.0	8.0	5.0
3	8/06/81	alone	9.7	6.0	8.9	5.5
4	9/29/81	1 bull/1 cow w/calf	11.6	7.2	6.4	4.0
5	11/09/81	alone	13.7	8.5	10.9	6.8
6	1/14/82	3 cows/2 yrlg bulls	3.7	2.3	16.3	10.1
7	3/11/82	6 adults/1 calf	3.7	2.3	10.1	6.3
8	4/20/82	alone	1.3	0.8	7.7	4.8
9	5/07/82	4 adults	1.0	0.6	1.1	0.7
10	6/17/82	w/2 calves	9.7	6.0	8.7	5.4
11	6/30/82	alone	8.4	5.2	3.2	2.0
12	7/16/82	alone	10.5	6.5	2.8	1.8
13	10/08/82	alone	8.1	5.0	3.5	2.2
14	11/17/82	2 cows	1.3	0.8	7.2	4.5
15	3/14/82	5 adults	4.8	3.0	3.7	2.3
16	4/13/82	4 adults	2.6	1.6	2.3	1.4
17	6/16/83	w/2 calves	10.1	6.3	11.3	7.0
18	6/28/83	w/2 calves	7.4	4.6	3.2	2.0
19	7/11/83	w/2 calves	8.5	5.3	1.6	1.0
20	8/30/83	w/2 calves	8.5	5.3	1.3	0.8
21	1/04/84	w/2 calves	10.6	6.6	13.2	8.2
Totals			143.2	88.9	131.4	81.8
Mean distance between sightings			7.2	4.4	6.6	4.1

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 5 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 5

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	w/2 yrlg[a]	--	--	--	--
2	5/26/81	w/1 calf	27.4	17.0	27.4	17.0
3	8/06/81	not sighted	48.4	30.1	22.5	14.0
4	9/16/81	1 cow	50.5	31.4	1.6	1.0
5	9/29/81	w/1 calf/1 bull	52.8	32.8	5.5	3.4
6	11/09/81	w/1 calf/1 50" bull	41.0	25.5	9.8	6.1
7	1/26/82	w/1 calf/12 adults and 1 calf	9.0	5.6	47.0	29.2
8	3/02/82	w/1 calf	12.2	7.6	11.9	7.4
9	4/09/82	w/1 yrlg	13.4	8.3	1.3	0.8
10	5/07/82	w/1 yrlg	10.1	6.3	23.7	14.7
11	6/16/82	w/2 calves	43.4	27.0	33.4	20.8
12	6/30/82	w/2 calves	51.2	31.8	9.5	5.9
13	8/05/82	w/1 calf	47.5	29.5	5.0	3.1
14	12/01/82	w/1 calf	45.7	28.4	1.6	1.0
15	3/15/83	w/1 calf	21.9	13.6	23.5	14.6
16	4/13/83	w/1 calf/1 cow	22.5	14.0	1.9	1.2
17	6/10/83	not sighted	49.6	30.8	30.6	19.0
18	6/28/83	alone	51.2	31.8	1.6	1.0
19	7/11/83	not sighted	45.4	28.2	5.8	3.6
20	8/16/83	alone	50.8	31.6	6.4	4.0
21	1/03/84	2 bulls/2 cows	34.3	21.3	17.7	11.0
Totals			728.3	437.3	287.7	178.8
Mean distance between sightings			36.4	21.9	14.4	8.9

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 6 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 6

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mk	From last sighting km	mi
1	4/22/81	w/2 yrlgs[a]	--	--	--	--
2	5/27/81	w/2 calves	2.4	1.5	2.4	1.5
3	9/16/81	w/2 calves	19.6	12.2	21.9	13.6
4	11/06/81	w/2 calves	25.1	15.6	31.7	19.7
5	1/14/82	w/2 calves & 6 adults	14.6	9.1	10.8	6.7
6	3/11/82	w/2 calves & 4 adults	8.8	5.5	15.8	9.8
7	4/20/82	w/2 yrlgs	6.6	4.1	10.0	6.2
8	5/07/82	not sighted	2.6	1.6	4.2	2.6
9	6/17/82	w/2 calves	2.6	1.6	0.5	0.3
10	6/30/82	w/2 calves	11.3	7.0	8.9	5.5
11	8/03/82	w/2 calves	22.7	14.1	26.7	16.6
12	10/08/82	w/2 calves	18.3	11.4	20.6	12.8
13	12/03/82	w/2 calves	20.9	13.0	7.6	4.7
14	3/14/83	w/2 calves & 2 adults	7.4	4.6	16.9	10.5
15	4/13/83	w/2 yrlgs	10.3	6.4	3.7	2.3
16	6/06/83	alone	6.1	3.8	4.5	2.8
17	7/14/83	not sighted	21.1	13.1	21.7	13.5
18	11/18/83	w/2 cows/1 calf	19.5	12.1	19.0	11.8
19	1/03/84	1 bull/2 cows/1 calf	19.3	12.0	2.7	1.7
Totals			239.2	148.7	229.4	142.6
Mean distance between sightings.			12.6	7.8	12.1	7.5

[a]Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 7 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	6/03/81	w/calf	65.8	41.0	65.8	41.0
3	9/17/81	w/calf & 1-60" bull	49.9	31.0	20.4	12.7
4	11/06/81	w/calf & 1-60" bull	38.0	23.6	23.3	14.5
5	1/27/82	alone	1.8	1.1	36.4	22.6
6	3/02/82	w/1 calf	1.6	1.0	3.4	2.1
7	4/09/82	6 adults/20 adults (¼ mile)	1.3	0.8	0.5	0.3
8	5/07/82	12 adults	26.9	16.7	27.8	17.3
9	6/11/82	alone	66.0	41.0	41.0	25.5
10	6/26/82	2 bulls (300 yards away)	70.0	43.5	4.5	2.9
11	8/05/82	alone	33.0	20.5	37.2	23.2
12	10/07/82	4 bulls (#58)/1 cow	47.0	29.2	15.3	9.5
13	11/30/82	1 cow	1.8	17.1	27.0	16.8
14	3/15/83	alone	13.5	8.4	16.3	10.1
15	4/13/83	alone	19.0	11.8	5.8	3.6
16	6/10/83	1 cow	29.4	18.3	12.1	7.5
17	1/04/84	alone	22.5	14.0	15.0	9.3
18	1/20/84	1 bull/2 adults	27.4	17.0	7.2	4.5
Totals			514.9	336.0	366.8	249.3
Mean distance between sightings			28.5	18.7	20.4	13.6

Appendix A. Group composition and movements of moose No. 8 by individual location, April 1981-January 1983.

Sex Female Age (April 1981) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	6/03/81	w/1 calf	64.4	40.0	64.4	40.0
3	9/16/81	3 cows/1-60" bull	61.3	38.1	10.5	6.5
4	11/06/81	3 cows/5 bulls	57.6	35.8	16.1	10.0
5	2/09/82	3 adults	9.8	6.1	48.1	29.9
6	3/11/82	3 adults	27.2	16.9	17.4	10.8
7	4/20/82	1 adult	59.2	36.8	34.0	21.1
8	5/17/82	1 adult/1 cow&calf	60.3	37.5	1.1	0.7
9	6/25/82	w/1 calf	60.8	37.8	1.9	1.2
10	8/03/82	w/1 calf	59.4	36.9	7.4	4.6
11	10/08/82	w/1 calf	60.0	37.3	3.2	2.0
12	12/03/82	w/1 calf	10.5	6.5	64.0	39.8
13	2/16/83	w/1 calf	10.6	6.6	20.6	12.8
14	4/26/83	w/1 yrlg[a]	26.6	16.5	9.0	5.6
15	6/10/83	not sighted	60.3	37.5	36.4	22.6
16	7/14/83	w/1 calf	60.5	37.6	0.5	0.3
17	10/17/83	w/1 calf	57.1	35.5	11.3	7.0
18	1/20/83	1 bull	58.9	36.6	5.8	3.6
Totals			750.5	470.0	351.7	218.5
Mean distance between sightings			41.7	26.1	19.5	12.1

[a]Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 9 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 9

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/2 yrlgs[a]	--	--	--	--
2	6/09/81	not sighted	40.1	24.9	40.1	24.9
3	9/17/81	w/1 calf	43.3	26.9	4.8	3.0
4	11/04/81	w/1 calf	38.0	23.6	3.2	2.0
5	1/27/82	w/1 calf	1.8	1.1	36.7	22.8
6	3/02/82	alone	3.9	2.4	1.5	0.9
7	4/09/82	2 adults/2 calves	3.7	2.3	0.6	0.4
8	5/07/82	3 adults	0.2	0.1	2.3	1.4
9	6/15/82	w/1 calf	44.3	27.5	44.3	27.5
10	7/14/82	w/1 calf	44.3	27.6	.0	.0
11	10/07/82	w/1 calf	45.1	28.0	2.9	1.8
12	12/03/82	w/1 calf	56.0	34.8	20.3	12.6
13	2/16/83	w/1 calf	9.8	6.1	54.4	33.8
14	4/13/83	w/1 calf	5.6	3.5	7.2	4.5
15	6/13/83	alone	42.6	26.5	37.0	23.0
16	7/14/83	alone	44.3	27.5	5.3	3.3
17	11/16/83	5 bulls/5 cows	40.7	25.3	3.7	2.3
18	1/20/84	7 adults	6.4	4.0	36.0	22.4
Totals			470.1	266.8	300.3	186.6
Mean distance betweeen sightings			26.1	14.8	16.7	10.4

[a]Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 10 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 4

Observ. number	Date	Group size & composition (excluding) collared moose)	Distance traveled: From point of capture km	Distance traveled: From point of capture mi	Distance traveled: From last sighting km	Distance traveled: From last sighting mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	6/04/81	1 bull	72.4	45.0	72.4	45.0
3	6/09/81	alone	74.8	46.5	3.2	2.0
4	9/16/81	1-60"bull/1cow&calf	66.9	41.6	17.9	11.1
5	2/09/82	2 adults	68.9	42.8	11.4	7.1
6	3/15/82	2 adults	66.9	41.6	5.5	3.4
7	4/29/82	not sighted	60.5	37.6	8.7	5.4
8	6/11/82	w/2 calves	75.3	46.8	16.1	10.0
9	8/03/82	w/2 calves	79.2	49.2	4.5	2.8
10	10/12/82	w/2 calves	74.2	46.1	12.6	7.8
11	12/02/82	w/2 calves	72.9	45.3	9.3	5.8
12	3/14/83	w/2 calves	10.9	6.8	62.9	39.1
13	4/26/83	w/2 yrlgs	10.9	6.8	1.6	1.0
14	6/22/83	w/1 calf	74.8	46.5	65.6	40.8
15	7/14/83	w/1 calf	73.5	45.7	1.6	1.0
16	1/20/84	w/1 calf	75.6	47.0	4.0	2.5
Totals			957.8	595.3	297.3	184.8
Mean distance between sightings			59.9	37.2	18.6	11.6

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 11 by individual location, April 1981-June 1982.

Sex Female Age (April 1981) 17

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	6/03/81	alone	96.5	60.0	96.5	60.0
3	9/17/81	cow w/1 calf	60.3	37.5	37.0	23.0
4	11/09/81	alone	--	--	35.4	22.0
5	1/27/82	2 bulls/3 cows & 1 calf	18.5	11.5	43.4	27.0
6	3/02/82	alone	8.0	5.0	25.7	16.0
7	4/09/82	alone	16.1	10.0	9.8	6.1
8	5/07/82	2 adults	13.8	8.6	25.3	15.7
9	6/21/82	moose dead, probably died from natural causes	56.0	34.8	41.8	26.0
Totals			269.3	167.4	315.0	195.8
Mean distance between sightings			29.9	18.6	35.0	21.8

Appendix A. Group composition and movements of moose No. 12 by individual location, April 1981-December 1982.

Sex Female Age (April 1981) 7

Observ. number	Date	Group size & composition excluding collared moose)	Distance traveled: From point of capture km	Distance traveled: From point of capture mi	Distance traveled: From last sighting km	Distance traveled: From last sighting mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	6/03/81	w/2 calves	48.3	30.0	48.3	30.0
3	9/16/81	w/2 calves	46.2	28.7	6.8	4.2
4	11/06/81	w/2 calves	42.8	26.6	3.5	2.2
5	1/14/82	w/2 calves	16.4	10.2	59.2	36.8
6	3/11/82	w/2 calves	19.8	12.3	12.7	7.9
7	4/20/82	w/2 yrlgs	4.3	2.7	24.0	14.9
8	5/07/82	50 adults	4.2	2.6	4.2	2.6
9	6/17/82	w/2 calves	47.5	29.5	46.7	29.0
10	8/03/82	w/1 calf	38.0	23.6	10.0	6.2
11	10/08/82	w/1 calf/1 bull	39.9	24.8	2.3	1.4
12	12/02/82	w/1 calf/3 cows	30.7	19.1	9.5	5.9
13	12/17/82	killed by hunter	unk	unk	unk	unk
Totals			338.1	210.1	227.0	141.1
Mean distance between sightings.			26.0	16.2	17.5	10.9

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 13 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	5/27/81	w/2 calves	6.4	4.0	6.4	4.0
3	9/17/81	not sighted	15.8	9.8	16.1	10.0
4	11/06/81	w/1 calf	6.0	3.7	11.6	7.2
5	1/14/82	w/1 calf/1 cow	11.6	7.2	16.6	10.3
6	3/11/82	w/1 calf/9 adults	10.9	6.8	2.1	1.3
7	4/20/82	w/1 yrlg	8.4	5.2	4.5	2.8
8	5/17/82	w/1 calf	4.8	3.0	9.0	5.6
9	6/16/82	alone	6.3	3.9	1.6	1.0
10	8/03/82	1 cow	1.9	1.2	3.2	2.0
11	10/08/82	1 cow	14.6	9.1	12.9	8.0
12	11/17/82	alone	3.2	2.0	14.2	8.8
13	3/14/83	8 adults	5.3	3.3	8.7	5.4
14	4/26/83	1 adult	11.3	7.0	5.3	3.3
15	6/06/83	w/2 calves	7.4	4.6	17.9	11.1
16	6/28/83	w/2 calves	7.2	4.5	2.4	1.5
17	7/14/83	w/2 calves	7.2	4.5	0.8	0.5
18	8/30/83	w/2 calves	5.6	3.5	1.6	1.0
19	1/03/84	w/2 calves	7.2	4.2	2.4	1.5
Totals			141.2	87.8	137.2	85.3
Mean distance between sightings.			7.4	4.6	7.2	4.5

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 14 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 14

Observ. Number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	5/27/81	w/1 yrlg	16.7	10.4	16.7	10.4
3	6/09/81	w/2 calves	16.9	10.5	2.6	1.6
4	8/06/81	w/2 calves	15.5	9.6	20.1	12.5
5	11/09/81	w/2 calves	15.1	9.4	3.5	2.2
6	1/14/82	w/2 calves	3.2	2.0	18.2	11.3
7	3/11/82	w/2 calves/12 adults	0.8	0.5	2.6	1.6
8	4/20/82	w/2 yrlgs	1.8	1.1	1.8	1.1
9	5/17/82	w/2 yrlgs	13.5	8.4	13.4	8.3
10	6/17/82	w/2 calves	13.5	8.4	1.3	0.8
11	6/30/82	w/2 calves	14.8	9.2	9.7	0.6
12	7/18/82	w/1 calf	13.7	8.5	1.5	0.9
13	10/08/82	w/1 calf	12.6	7.8	25.7	16.0
14	12/03/82	w/1 calf	1.5	0.9	14.3	8.9
15	3/14/83	w/1 calf	20.6	12.8	19.3	12.0
16	4/26/83	w/yrlg/2 adults	3.1	1.9	17.7	11.0
17	6/06/83	w/2 calves	3.2	2.0	0.2	0.1
18	6/28/83	alone	15.3	9.5	12.1	7.5
19	7/14/83	alone	12.9	8.0	2.9	1.8
20	8/30/83	1 bull	13.0	8.1	1.3	0.8
21	12/02/83	5 bulls/9 cows	8.9	5.5	21.7	13.5
22	1/20/84	2 adults	4.8	3.0	13.7	8.5
Totals			221.4	135.7	220.3	131.4
Mean distance between sightings			10.1	6.2	10.0	6.0

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 15 by individual location, April 1981-July 1983.

Sex Female Age (April 1981) 2

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	6/03/81	cow & calf	47.6	29.6	47.6	29.6
3	6/09/81	1 cow/1 yrlg	61.8	38.4	14.5	9.0
4	9/17/81	9 cows/2 bulls	68.4	42.5	16.1	10.0
5	11/09/81	1 cow/2 yrlg bulls	77.9	48.4	10.5	6.5
-	2/09/82	no signal	--	--	--	--
-	3/25/82	no signal	--	--	--	--
-	4/09/82	no signal	--	--	--	--
6	6/11/82	w/1 calf	65.2	40.5	14.9	9.2
7	8/05/82	w/1 calf	47.6	29.6	19.3	12.0
8	10/07/82	w/1 calf	49.2	30.6	3.7	2.3
9	12/03/82	w/1 calf/2 adults	11.4	7.1	38.3	23.8
10	3/15/83	w/1 calf	4.3	2.7	14.3	8.9
11	4/26/83	w/1 calf	14.6	9.1	18.2	11.3
12	6/22/83	alone	51.5	32.0	37.0	23.0
13	7/14/83	not sighted	40.2	25.0	13.2	8.2
Totals			539.7	306.7	247.6	153.8
Mean distance between sightings			41.5	23.6	19.1	11.8

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 16 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 5

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	5/26/81	alone	8.9	5.5	8.9	5.5
3	6/09/81	w/yrlg	10.5	6.5	1.3	0.8
4	8/06/81	w/1 yrlg bull	15.9	9.9	25.3	15.7
5	11/09/81	alone	19.6	12.2	1.0	0.6
6	1/14/82	alone	2.6	1.6	19.6	12.2
7	3/02/82	3 adults incl. #20	2.3	1.4	2.4	1.5
8	4/09/82	alone	2.3	1.4	1.5	0.9
9	5/07/82	w/1 cow	2.3	1.4	0.0	0.0
10	6/16/82	w/1 calf	9.0	5.6	8.1	5.0
11	6/30/82	w/1 calf	2.6	1.6	6.6	4.1
12	7/18/82	w/1 calf	11.4	7.1	13.0	8.1
13	10/07/82	w/1 calf	26.2	16.3	15.0	9.3
14	12/01/82	w/1 calf	2.1	1.3	28.2	17.5
15	2/16/83	w/1 calf	3.7	2.3	5.0	3.1
16	4/13/83	w/1 yrlg	6.1	3.8	2.9	1.8
17	6/10/83	alone	8.1	5.0	14.2	8.8
18	6/28/83	alone	4.0	2.5	4.5	2.8
19	7/22/83	not sighted	0.8	0.5	4.0	2.5
20	10/31/83	2 bulls	18.7	11.6	19.0	11.8
21	1/03/84	alone	18.2	11.3	2.4	1.5
Totals			175.3	108.8	288.8	182.9
Mean distance between sightings			8.4	5.2	13.8	8.7

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 17 by individual location, April 1981-June 1983.

Sex Female Age (April 1981) 13

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled From point of capture Kk	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	alone	--	--	--	--
2	5/27/81	alone	4.2	2.6	4.2	2.6
3	6/09/81	alone	8.4	5.2	12.1	7.5
4	9/16/81	w/1 small calf (75 lbs.)	8.7	5.4	1.9	1.2
5	11/16/81	w/1 small calf	17.4	10.8	8.9	5.5
6	1/14/82	w/1 calf	3.4	2.1	16.3	10.1
7	3/11/82	w/1 calf	12.1	7.5	11.1	6.9
8	4/20/82	w/1 yrlg[a]	12.1	7.5	0.0	0.0
9	5/07/82	w/1 yrlg	12.1	7.5	0.0	0.0
10	6/17/82	w/1 yrlg	16.9	10.5	22.2	13.8
11	6/30/82	w/1 yrlg	10.9	6.8	8.4	5.2
12	7/18/82	w/1 yrlg	10.0	6.2	2.9	1.8
13	10/12/82	w/1 yrlg bull	17.7	11.0	22.2	13.8
14	12/03/82	w/1 yrlg bull	23.2	14.4	13.7	8.5
15	2/16/83	w/1 yrlg bull	22.7	14.1	1.1	0.7
16	4/13/83	w/1 yrlg bull	14.0	8.7	9.8	6.1
17	6/06/83	moose dead, probably killed by predators	7.9	4.9	18.5	11.5
Totals			326.9	125.2	575.4	422.1
Mean distance between sightings			19.2	7.4	33.8	24.8

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 18 by individual location, April 1981-April 1983.

Sex Female Age (April 1981) 4

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	Distance traveled: From point of capture mi	Distance traveled: From last sighting km	Distance traveled: From last sighting mi
1	4/22/81	alone	--	--	--	--
2	5/26/81	alone	46.7	29.0	46.7	29.0
3	9/17/81	2 bulls/7 cows	59.5	37.0	39.4	24.5
4	11/09/81	alone	79.0	49.1	25.1	15.6
5	1/26/82	2 cows/1 calf	1.8	1.1	77.2	48.0
6	3/02/82	alone	1.8	1.1	0.0	0.0
7	4/09/82	4 adults/4 yrlgs[a]	0.5	0.3	16.3	10.1
8	5/07/82	2 adults	51.7	32.1	34.6	21.5
9	10/07/82	1 bull/2 cows	71.3	44.3	23.2	14.4
10	11/30/82	4 cows/1 calf	52.3	32.5	22.5	14.0
11	3/15/83	alone	7.6	4.7	59.2	36.8
12	4/13/83	alone	9.0	5.6	16.6	10.3
Totals			318.2	236.8	360.8	224.2
Mean distance between sightings			31.8	19.7	30.1	18.7

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 19 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 8

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/26/81	alone	27.4	17.0	27.4	17.0
3	8/06/81	not sighted	27.0	16.8	0.5	0.3
4	11/09/81	alone	27.4	17.0	34.0	21.1
5	1/26/82	1 bull (#26)/5 cows	2.1	1.3	27.0	16.8
6	3/02/82	w/1 cow	0.8	0.5	1.3	0.8
7	4/09/82	11 adults (#3&27) 8 yrlgs[a]	0.6	0.4	0.8	0.5
8	5/07/82	3 adults (#60)	1.9	1.2	2.4	1.5
9	6/16/82	w/1 calf	22.2	13.8	24.1	15.0
10	6/30/82	not sighted	29.6	18.4	4.7	2.9
11	10/12/82	1 cow	32.0	19.9	30.6	19.0
12	12/01/82	2 adults	4.5	2.8	31.4	19.5
13	2/16/83	9 adults	0.2	0.1	4.2	2.6
14	4/13/83	2 adults	1.0	0.6	0.8	0.5
15	6/08/83	w/2 calves	20.6	12.8	23.2	14.4
16	6/28/83	w/1 calf	24.1	15.0	3.4	2.1
17	7/21/83	w/1 calf	14.3	8.9	12.9	8.0
18	1/03/84	w/1 calf	23.3	14.5	11.9	7.4
Totals			259.0	161.0	240.6	149.4
Mean distance between sightings			14.4	8.9	13.4	8.3

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 20 by individual location, April 1981-January 1984.

Sex Female Age (April 1981) 6

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	w/1 yrlg[a]	--	--	--	--
2	5/26/81	w/2 calves	16.1	10.0	16.1	10.0
3	9/16/81	1-60" bull/10 cows	39.9	24.8	28.0	17.4
4	11/09/81	1 bull/4 cows & 1 calf	40.2	25.0	5.5	3.4
5	1/26/82	2 cows & 2 calves	7.9	4.9	40.4	25.1
6	3/02/82	4 adults (incl. #16)	6.3	3.9	2.4	1.5
7	4/09/82	6 adults & 1 calf	8.7	5.4	3.1	1.9
8	5/17/82	alone	6.8	4.2	2.3	1.4
9	6/16/82	w/2 calves	16.7	10.4	11.3	7.0
10	6/30/82	w/1 calf	13.2	8.2	4.2	2.6
11	8/05/82	w/1 calf	27.4	17.0	16.4	10.2
12	10/12/82	w/1 calf	39.1	24.3	11.6	7.3
13	12/01/82	w/1 calf	4.8	3.0	39.0	24.3
14	3/14/83	w/1 calf	8.9	5.5	4.0	2.5
15	4/13/83	w/1 yrlg	7.7	4.8	1.6	1.0
16	6/10/83	alone	15.1	9.4	13.0	8.1
17	6/28/83	alone	41.5	25.8	29.0	18.0
18	7/21/83	not sighted	42.2	26.2	4.8	3.0
19	1/03/84	1 adult	34.3	21.3	10.0	6.2
Totals			376.8	260.3	242.7	150.9
Mean distance between sightings			19.8	13.7	12.8	7.9

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 21 by individual location, April 1981-January 1984.

Sex Male Age (April 1981) 8

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	Distance traveled: From point of capture mi	Distance traveled: From last sighting km	Distance traveled: From last sighting mi
1	4/22/81	alone	--	--	--	--
2	5/22/81	alone	57.9	36.0	57.9	36.0
3	9/17/81	alone	56.3	35.4	1.6	1.0
4	11/06/81	4 bulls/6 cows & 2 calves	53.1	32.5	8.0	4.8
5	1/14/82	1 bull	17.7	11.0	34.4	21.4
6	3/11/82	15 adults	17.9	11.1	0.6	0.4
7	4/20/82	5 adults	16.7	10.4	2.1	1.3
8	5/07/82	1 adult	16.7	10.4	0.0	0.0
9	6/25/82	alone	59.5	37.0	42.6	26.5
10	8/05/82	1 bull/1 cow	53.3	33.1	7.7	4.8
11	10/07/82	1 bull/1 cow	54.6	33.9	19.5	12.1
12	2/16/83	alone	36.0	22.4	18.8	11.7
13	4/26/83	alone	29.9	18.6	8.9	5.5
14	6/10/83	alone	59.2	36.8	31.9	19.8
15	7/14/83	1 bull	54.4	33.8	9.8	6.1
16	1/03/84	alone	58.7	36.5	13.8	8.6
Totals			641.9	398.9	257.6	160.0
Mean distance between sightings			40.1	24.9	16.1	10.0

Appendix A. Group composition and movements of moose No. 22 by individual location, April 1981-January 1984.

Sex Male Age (april 1981) 4

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/27/81	2 bulls (#39)	1.6	1.3	1.6	1.3
3	9/16/81	alone	9.6	5.5	11.3	7.2
4	11/09/81	alone	3.2	2.4	11.3	7.2
5	11/25/81	cow & calf	1.0	0.6	4.0	2.5
6	1/14/82	1 bull/1 cow & 2 calves	8.2	5.1	7.9	4.9
7	3/11/82	1 adult	2.6	1.6	9.3	5.8
8	4/20/82	alone	5.2	3.2	5.5	3.4
9	5/07/82	9 adults	6.6	4.1	1.9	1.2
10	6/16/82	alone	1.5	0.9	6.4	4.0
11	7/18/82	alone	8.7	5.4	7.4	4.6
12	8/05/82	1 bull (#54)	8.7	5.4	3.2	2.0
13	10/08/82	1 cow	2.4	1.5	6.9	4.3
14	11/17/82	alone	9.0	5.6	7.2	4.5
15	3/15/83	cow & 1 calf	3.1	1.9	9.3	5.8
16	4/13/83	4 adults	7.9	4.9	4.8	3.0
17	6/06/83	alone	3.7	2.3	10.5	6.5
18	7/14/83	not sighted	8.5	5.3	5.2	3.2
19	8/30/83	alone	5.5	3.4	2.9	1.8
20	1/03/84	alone (no antlers)	1.6	1.0	5.6	3.7
Totals			90.6	61.4	122.2	76.9
Mean distance between sightings			4.5	3.1	6.1	3.8

Appendix A. Group composition and movements on moose No. 23 by individual location, April 1981-September 1982.

Sex Male Age (April 1981) 8

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/26/81	cow & 1 calf	8.0	4.5	8.0	4.5
3	8/06/81	3 bulls (#30)/ 5 cows & 1 calf	54.7	34.0	48.3	29.9
4	11/09/81	alone	27.3	17.1	56.3	35.2
5	2/09/82	not sighted	36.5	22.7	54.1	33.6
6	3/02/82	alone	33.3	20.7	17.2	10.7
7	4/09/82	2 adults/2 cows & 2 calves	28.2	17.5	12.1	7.5
8	5/07/82	13 adults	9.8	6.1	18.5	11.5
9	6/15/82	1 bull	18.5	11.5	9.7	6.0
10	8/05/82	alone	16.3	10.1	12.9	8.0
11	9/12/82	moose killed by hunter	20.9	13.0	6.9	4.3
Totals			253.5	157.2	244.0	151.2
Mean distance between sightings			23.1	14.3	22.2	13.7

Appendix A. Group composition and movements of moose No. 26 by individual location, April 1981-January 1984.

Sex Male Age (April 1981) 11

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	alone	--	--	--	--
2	5/22/81	1 yrlg[a] bull	8.0	5.4	8.0	5.4
3	8/06/81	alone	11.2	6.9	3.2	2.0
4	11/04/81	1-60" bull/5 cows/ 1 calf	28.9	17.8	17.7	11.2
5	1/26/82	7 adults (#19)	9.0	5.6	22.9	14.2
6	3/02/82	1 adult	0.6	0.4	1.3	0.8
7	4/09/82	4 adults/1 calf	10.0	6.2	0.3	0.2
8	5/07/82	2 adults	6.3	3.9	3.7	2.3
9	6/15/82	alone	12.1	7.5	7.9	4.9
10	8/05/82	alone	15.8	9.9	7.6	4.8
11	10/07/82	3 yrlg bulls	25.1	15.6	16.3	10.1
12	11/30/82	1 bull/2 cows (#10)	17.7	11.0	9.2	5.7
13	2/16/83	alone	15.1	9.4	3.7	2.4
14	4/26/83	alone	11.1	6.9	4.2	2.6
15	6/08/83	2 bulls	18.7	11.6	7.9	4.9
16	7/21/83	1 bull	18.5	11.5	1.6	1.0
17	11/14/83	3 bulls (#40)	23.3	14.5	5.6	3.5
18	1/20/84	alone	21.9	13.6	2.4	1.5
Totals			253.3	157.7	123.5	77.5
Mean distance between sightings			14.1	8.8	6.9	4.3

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 27 by individual location, April 1981-October 1982.

Sex Male Age (April 1981) 5

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/26/81	3 cows/1 yrlg[a]	12.8	8.4	12.8	8.4
3	9/17/81	alone	46.7	28.6	53.1	32.9
4	11/16/81	not sighted	25.7	16.1	55.1	28.2
5	1/26/82	alone	12.4	7.7	36.9	22.9
6	3/02/82	4 adults	20.9	13.0	15.6	9.7
7	4/09/82	11 adults (#3,19) 8 calves	4.3	2.7	19.5	12.1
8	5/07/82	5 adults	6.1	3.8	1.8	1.1
9	6/11/82	alone	28.2	17.5	34.1	21.2
10	8/05/82	3 bulls	33.8	21.0	5.8	3.6
11	10/07/82	1 cow	34.3	21.3	3.7	2.3
12	10/09/82	moose killed by hunter	--	--	--	--
Totals			225.2	140.1	238.5	142.4
Mean distance between sightings			18.8	11.7	19.9	11.9

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 29 by individual location, April 1981-July 1982.

Sex Female Age (April 1981) 10

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/27/81	w/2 calves	57.9	35.8	57.9	35.8
3	9/16/81	w/2 cows	57.9	36.0	0.3	0.2
4	11/06/81	w/2 calves	37.0	22.8	35.4	21.6
5	1/14/82	w/2 calves	1.6	1.0	44.3	27.5
6	3/11/82	w/2 calves	1.6	1.0	0.0	0.0
7	4/20/82	w/1 yrlg[a]	1.6	1.0	1.6	1.0
8	5/07/82	w/2 calves	7.1	4.4	6.1	3.8
9	6/17/82	w/1 calf	57.9	36.0	52.3	32.5
10	7/18/82	moose dead, probably from natural causes	58.2	36.2	6.6	4.1
Totals			280.8	174.2	204.5	121.5
Mean distance between sightings			28.1	17.4	20.5	12.2

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 30 by individual location, April 1981-January 1984.

Sex Male Age (April 1981) Unk.

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	alone	--	--	--	--
2	6/03/81	alone	57.9	35.5	57.9	35.5
3	9/25/81	1 bull/1 cow & calf	61.1	38.0	6.4	4.0
4	11/19/81	1 cow	6.4	4.0	61.3	38.1
5	1/27/82	4 adults	68.4	42.9	13.8	8.6
6	3/15/82	5 adults/2 calves	63.9	39.7	4.2	2.6
7	4/20/82	1 adult	65.8	40.9	7.4	4.6
8	5/17/82	1 adult	61.5	38.2	4.7	2.9
9	6/16/82	alone	57.9	36.0	7.2	4.5
10	8/03/82	12 bulls/3 cows	63.6	39.5	37.0	23.0
11	10/08/82	alone	15.0	9.3	64.0	39.8
12	12/03/82	2 bulls/1 cow & 2 calves	5.3	3.3	16.3	10.1
13	3/14/83	4 adults	4.8	3.0	1.0	.6
14	4/26/83	3 adults	7.9	4.9	4.8	3.0
15	11/18/83	alone	27.5	14.0	22.5	14.0
16	1/25/84	alone	16.9	10.5	5.6	3.5
Totals			578.9	359.3	314.1	194.8
Mean distance between sightings			36.1	22.5	19.6	12.2

Appendix A. Group composition and movements of moose No. 34 by individual location, April 1981-January 1984.

Sex Male Age (April 1981) 8

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/27/81	4 bulls/1 cow	20.9	12.9	20.9	12.9
3	9/16/81	1 yrlg[a] bull/ 1 cow & calf	16.1	10.0	8.0	4.6
4	11/09/81	not sighted	22.5	14.1	8.0	4.8
5	2/09/82	11 adults/36" bull	8.7	5.4	14.6	9.1
6	3/15/82	6 adults	19.5	12.1	11.1	6.9
7	4/20/82	1 bull	13.4	8.3	6.9	4.3
8	5/07/82	10 adults	4.8	3.0	3.7	2.3
9	6/24/82	4 bulls	14.1	8.8	9.5	5.9
10	7/18/82	alone	18.5	11.5	4.6	2.9
11	10/12/82	cow & 2 calves	15.9	9.4	4.7	2.8
12	2/16/83	2 adults	20.8	12.9	9.2	5.7
13	4/26/83	alone	8.7	5.4	12.1	7.5
14	6/06/83	2 bulls	15.3	9.5	7.2	4.5
15	7/21/83	1 bull	15.1	9.4	6.4	4.0
16	12/02/83	1 cow	14.7	9.2	12.2	7.2
17	1/03/84	not sighted	13.8	8.6	6.8	4.2
Totals			242.8	150.5	145.9	89.6
Mean distance between sightings			14.3	8.9	8.6	5.3

[a] Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 35 by individual location, April 1981-January 1984.

Sex Male Age (April 1981) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/26/81	alone	--	--	--	--
2	5/26/81	alone	25.7	16.3	25.7	16.3
3	9/17/81	5 yrlg[a] bulls/ 2 cows	75.7	47.2	72.4	45.0
4	11/06/81	2 bulls/1 cow & calf	41.8	26.1	33.8	21.2
5	11/22/81	4 bulls/4 cows	25.3	15.7	27.2	17.0
6	1/26/82	alone	42.6	26.5	18.8	11.7
7	3/15/82	17 adults	23.5	14.6	19.0	11.8
8	4/19/82	alone	26.1	16.2	4.3	2.7
9	5/07/82	5 adults	35.1	21.8	2.1	1.3
10	6/16/82	alone	78.8	49.0	62.4	38.8
11	8/05/82	not sighted	--	--	--	--
12	10/12/82	3 bulls/1 cow & calf	65.6	40.8	15.5	9.6
13	12/02/82	1 cow	33.6	20.9	33.6	20.9
14	2/16/83	9 adults	26.4	16.4	34.4	21.4
15	4/13/83	alone	27.4	17.0	0.9	0.5
16	6/10/83	2 cows	28.6	17.8	1.6	1.0
17	7/14/83	alone	76.4	47.5	72.0	44.8
18	10/31/83	cow & 1 calf	47.5	29.5	37.2	23.1
19	1/03/84	not sighted	63.2	39.3	28.6	17.8
Totals			743.3	462.6	489.5	304.9
Mean distance between sightings			39.1	24.3	25.8	16.1

[a]Yearlings are 10-12 old month calves.

Appendix A. Group composition and movements of moose No. 36 by individual location, April 1981-January 1984.

Sex Male Age April 1981) 7

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	alone	--	--	--	--
2	5/27/81	alone	1.6	1.0	1.6	1.0
3	9/16/81	1 bull/2 cows	16.1	10.3	16.1	10.2
4	11/06/81	alone	17.7	10.6	1.6	1.0
5	1/14/82	alone	10.0	6.2	13.4	8.3
6	3/11/82	alone	12.4	7.7	18.8	11.7
7	4/20/82	5 adults	12.9	8.0	4.3	2.7
8	5/07/82	5 adults	13.4	8.3	0.5	0.3
9	6/16/82	alone	1.6	1.0	13.2	8.2
10	7/18/82	1 bull	8.7	5.4	7.1	4.4
11	10/12/82	cow & 1 calf	8.9	5.5	5.2	3.3
12	11/17/82	alone	6.3	3.9	3.0	1.9
13	3/15/83	alone	7.9	4.9	1.7	1.0
14	4/25/83	alone	11.9	7.4	18.9	11.8
15	6/06/83	alone	12.9	8.0	22.5	14.0
16	7/14/83	alone	13.7	8.5	2.6	1.6
17	8/30/83	alone	10.9	6.8	3.2	2.0
18	1/03/84	alone (no antlers)	5.6	3.5	10.8	6.7
Totals			172.5	107.0	144.5	901.0
Mean distance between sightings			9.6	5.9	8.0	5.0

Appendix A. Group composition and movements of moose No. 37 by individual location, April 1981-September 1983.

Sex Male Age (April 1981) 4

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/81	alone	--	--	--	--
2	5/26/81	3 adults	12.8	8.0	12.8	8.0
3	9/17/81	2 bulls	16.1	20.0	27.3	17.0
4	11/06/81	2 cows & 2 calves	35.4	22.2	17.7	10.8
5	1/27/82	2 adults	17.7	11.0	20.0	12.4
6	3/02/82	alone	20.1	12.5	5.8	3.6
7	4/09/82	2 adults	30.6	19.0	10.9	6.8
8	5/07/82	alone	29.4	18.3	2.9	1.8
9	6/16/82	alone	39.4	24.5	11.9	7.4
10	8/05/82	not sighted	39.8	24.8	0.8	0.5
11	10/07/82	1 cow	38.6	24.1	10.1	6.3
12	12/03/82	2 bulls/2 cows & 1 calf	16.9	10.5	25.8	16.0
13	2/16/83	not sighted	21.5	13.4	6.5	4.0
14	4/13/83	2 adults	19.3	12.0	5.4	3.4
15	6/10/83	1 adult	41.4	25.8	23.2	14.5
16	7/14/83	not sighted	33.3	20.7	8.4	5.2
17	9/25/83	moose killed by hunter	26.6	16.5	14.0	8.7
Totals			438.9	283.3	203.5	126.4
Mean distance between sightings			25.8	16.7	11.9	7.4

Appendix A. Group composition and movements of moose No. 40 by individual location, April 1981-January 1984.

Sex Male Age (April 1981) 9

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/22/81	alone	--	--	--	--
2	6/08/81	alone	3.2	2.4	3.2	2.4
3	9/17/81	3 cows	25.7	15.6	22.5	14.0
4	11/04/81	alone	24.1	14.7	3.2	1.7
5	1/26/82	6 adults	2.4	1.5	22.9	14.2
6	3/02/82	3 adults	2.4	1.5	0.0	0.0
7	4/09/82	4 adults	3.2	2.0	1.3	0.8
8	5/07/82	alone	3.4	2.1	2.4	1.5
9	6/15/82	alone	5.0	3.1	4.6	2.9
10	7/14/82	36" bull	22.9	14.2	20.1	12.5
11	10/07/82	2 yrlg[a] bulls/3 cows	20.8	12.9	4.0	2.5
12	12/01/82	60" bull/1 cow & 2 calves	10.8	6.7	10.1	6.3
13	2/16/83	alone	14.2	8.8	26.4	16.4
14	4/13/83	alone	14.5	9.0	2.9	1.8
15	6/10/83	alone	9.7	6.0	24.1	15.0
16	7/21/83	alone	19.8	12.3	11.4	7.1
17	10/31/83	4 bulls	16.1	10.0	3.6	2.3
18	11/14/83	3 bulls (#26)	17.7	11.0	3.2	2.0
19	1/20/84	unknown	1.6	1.0	7.7	4.8
Totals			217.5	134.8	173.6	108.2
Mean distance between sightings			11.5	7.1	9.1	5.7

[a]Yearlings are 10-12 month old calves.

Appendix A. Group composition and movements of moose No. 50 by individual location, April 1982-January 1984.

Sex Male Age (April 1981) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/27/82	unknown	--	--	--	--
2	5/07/82	4 adults	4.5	2.8	4.5	2.8
3	6/15/82	alone	13.5	8.4	12.5	7.8
4	7/14/82	alone	19.1	11.9	14.5	9.0
5	10/12/82	2 bulls/4 cows	18.1	11.3	3.8	2.4
6	2/16/83	7 adults	11.6	7.2	28.7	17.8
7	4/13/83	6 adults	4.5	2.8	14.2	8.8
8	6/08/83	alone	16.3	10.1	12.1	7.5
9	7/21/83	not sighted	24.1	15.0	8.5	5.3
10	10/31/83	3 bulls/4 cows	18.3	11.4	6.1	3.8
11	1/20/84	alone	19.3	12.0	1.4	0.9
Totals			149.3	92.9	106.4	66.1
Mean distance between sightings			13.6	8.5	9.7	6.0

Appendix A. Group composition and movements of moose No 51 by individual location, April 1982-November 1983.

Sex Male Age (April 1982) 2

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/22/82	unknown	--	--	--	--
2	5/07/82	13 adults (#23)	9.7	6.0	9.7	6.0
3	6/15/82	alone	15.3	9.5	6.0	3.8
4	7/14/82	alone	20.1	12.5	14.1	8.8
5	10/12/82	alone	17.1	10.6	9.3	5.8
6	11/30/82	1 cow	6.4	4.0	12.1	7.5
7	2/16/83	alone	25.7	16.0	22.3	13.8
8	4/13/83	6 adults	7.7	4.8	18.2	11.3
9	6/08/83	alone	22.5	14.0	16.9	10.5
10	7/21/83	1 bull	22.9	14.2	3.3	2.1
11	10/31/83	3 bulls/4 cows	20.1	12.5	4.4	2.8
12	11/14/83	7 bulls/6 cows	20.1	12.5	0.8	0.5
Totals			187.6	116.6	117.1	72.9
Mean distance between sightings			15.6	9.7	9.8	6.1

Appendix A. Group composition and movements of moose No. 53 by individual location, April 1982-September 1983.

Sex Male Age (April 1982) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	From point of capture mi	From last sighting km	From last sighting mi
1	4/27/82	unknown	--	--	--	--
2	5/17/82	1 cow & calf	42.5	26.4	42.5	26.4
3	6/15/82	2 bulls	41.0	25.5	1.4	0.9
4	10/12/82	2 bulls	61.1	38.0	30.8	19.1
5	12/03/82	alone	56.5	35.1	10.5	6.5
6	2/16/83	alone	63.9	39.7	11.1	6.8
7	4/26/83	2 adults	66.6	41.4	3.3	2.0
8	6/13/83	alone	56.5	35.1	11.6	7.2
9	7/21/83	alone	18.5	11.5	40.7	25.3
10	9/24/83	killed by hunter	56.6	35.2	40.7	25.3
Totals			463.2	287.9	192.6	119.5
Mean distance between sightings			46.3	28.8	19.3	12.0

Appendix A. Group composition and movements of moose No. 55 by individual location, April 1982-January 1984.

Sex Male Age (April 1982) 3

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/27/82	unknown	--	--	--	--
2	5/17/82	1 cow	16.1	10.0	16.1	10.0
3	6/17/82	alone	76.4	47.5	60.7	37.8
4	8/03/82	2 bulls	61.8	38.4	16.5	10.2
5	10/08/82	1 cow	63.6	39.5	13.4	8.3
6	12/02/82	alone	53.9	33.5	11.5	7.1
7	3/14/83	1 adult	63.9	39.7	12.7	7.9
8	4/27/83	1 adult	63.2	39.3	1.0	).6
9	6/22/83	1 bull	57.1	35.5	10.9	6.8
10	7/14/83	alone	51.2	31.8	7.7	4.8
11	1/03/84	not sighted	52.3	32.5	2.6	1.6
Totals			559.5	347.7	153.1	95.1
Mean distance between sightings			50.7	31.6	13.9	8.6

Appendix A. Group composition and movements of moose No. 56 by individual location, April 1982-January 1984.

Sex Male   Age (April 1982) 10

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled From point of capture km	mi	From last sighting km	mi
1	4/27/82	unknown	--	--	--	--
2	5/07/82	alone	28.0	17.4	28.0	17.4
3	6/16/82	alone	29.0	18.0	4.6	2.9
4	7/18/82	4 bulls	46.7	29.0	30.9	19.2
5	10/12/82	20 moose	40.2	25.0	10.9	6.8
6	3/14/83	3 adults	10.6	6.6	29.9	18.6
7	4/26/83	10 adults	10.3	6.4	0.8	0.5
8	6/06/83	2 bulls	12.5	7.8	2.2	1.4
9	7/13/83	not sighted	46.0	28.6	34.1	21.2
10	10/31/83	3 bulls/1 cow	42.2	26.3	4.8	3.0
11	1/13/84	4 adults	24.0	14.9	19.5	12.1
Totals			289.5	180.0	165.7	103.1
Mean distance between sightings			26.3	16.4	15.1	9.4

Appendix A. Group composition and movements of moose No. 58 by individual location, April 1982-December 1983.

Sex Male Age (April 1982) 8

Observ. number	Date	Group size & composition (excluding collared moose)	Distance traveled: From point of capture km	mi	From last sighting km	mi
1	4/27/82	unknown	--	--	--	--
2	5/07/82	7 adults	14.0	8.7	14.0	8.7
3	6/17/82	1 bull/1 cow & 1 calf	2.6	1.6	12.7	7.9
4	7/18/82	alone	18.5	11.5	16.3	10.1
5	10/07/82	1 bull/2 cows (#7)	69.8	43.4	54.3	33.8
6	2/16/83	alone	45.7	28.4	39.0	24.3
7	4/26/83	7 adults	28.2	17.5	17.7	11.0
8	6/10/83	1 bull	22.5	14.0	17.9	11.1
9	7/21/83	alone	18.7	11.6	11.4	7.1
10	12/30/83	moose dead, probably died of natural causes	14.5	9.0	6.1	3.8
Totals			234.5	145.7	189.4	117.8
Mean distance between sightings			23.5	14.6	18.9	11.8