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INTERIOR MOOSE STUDIES

BY
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Volume I

Final Report W-22-1
Projects W-17-9 through ~~W-21-2~~, Job No. 1.19R
and Project Progress Report
Federal Aid in Wildlife Restoration
Project ~~W-21-2~~ W-22-1, Jobs No. 1.26R and 1.32R

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JOB FINAL REPORT (RESEARCH)

State: Alaska

Cooperators: William C. Gasaway, Stephen D. DuBois, and Samuel J. Harbo

Project No.: W-17-9, W-17-10, ~~through~~ W-17-11, W-21-1, ~~and~~ W-21-2, & W-22-1   Project Title: Big Game Investigations

Job No.: 1.19R   Job Title: Standardization of Techniques for Estimating Moose Abundance

Period Covered: July 1, ~~1981~~ 1976 through June 30, 1982

SUMMARY

Moose sightability during aerial surveys was determined, and methods for estimating numbers and sex and age composition of moose were developed. The survey techniques manual is being revised for publication as an Alaska Department of Fish and Game (ADF&G) technical bulletin, and 2 training workshops were held. Personnel attending workshops conducted 4 population estimation surveys during October and November 1981. A manuscript on bias in aerial transect surveys during May and June was submitted for publication. Final analysis of winter sightability data is continuing.

Key words: aerial surveys, Alaska, *Alces*, moose, population estimation bias, sightability.

CONTENTS

BACKGROUND

One of the greatest problems in moose (Alces alces) management and research is the inability to accurately estimate numbers of moose. Accurate population estimates are difficult to obtain because of moose behavior and the type of preferred habitat. We selected this area of technique development for study because a completely satisfactory method of inventorying moose was not available.

Aerial survey methods for large mammals generally underestimate the numbers present because some animals are not seen (Caughley and Goddard 1972). Therefore, sightability estimates for animals seen under varying survey methods and environmental conditions are necessary to accurately estimate animal numbers. In the words of Caughley (1974):

> Sightability may be defined as the probability that an animal within an observer's field of search will be seen by the observer. The probability is determined by the distance between the animal and the observer; by such characteristics of location as thickness of cover, background, and lighting; by such characteristics of the animals as color, size, and movement; and by observer's eyesight, speed of travel, and level of fatigue.

Few sightability estimates existed for moose or other large animals from which reliable correction factors could be developed. Sightability estimates for moose in 4 2.6-km^2 pens were reported by LeResche and Rausch (1974). They found experienced observers who had recently conducted surveys saw an average of 68% of the moose under their experimental conditions. Search methods employed and terrain and habitat types available limited the application of these findings to other situations. Novak and Gardner (1975) estimated 90% sightability of moose during aerial transect surveys over 25 km^2 plots in a forested portion of Ontario. As a basis for calculating sightability, they assumed all moose present during the aerial surveys were later found by intensive searching of the plots by helicopter. Floyd et al. (1979) reported seeing 50% of the radio-collared deer in 1.3- to 26-km^2 forested test plots when these areas were intensively surveyed. Several studies have demonstrated that increasing search intensity increased moose sightability and population estimates (Fowle and Lumsden 1958; Evans et al. 1966; Lynch 1971; Mantle 1972); however, an unknown proportion of the moose present was probably not seen during even the most intensive searches. This, of course, precluded calculation of sightability.

In Alaska, variations of transect surveys have been used extensively to obtain sex and age composition data. When compared from year-to-year, these data provide useful insight into population trends. In a few cases, these data have been extrapolated to form crude estimates of population size, but the technique is generally considered inadequate for population estimation. Basically, the transect method involves flying parallel lines at prescribed altitudes and airspeed and counting moose seen in prescribed transect widths (Banfield et al. 1955). Population estimates derived in this manner are inaccurate because of 2 major problems: a) determination of transect width is difficult and b) the number of moose not seen is unknown and varies greatly with habitat types and environmental factors. Timmermann (1974) concluded the transect method was inadequate for the needs of wildlife management agencies and that quadrat sampling methods for the estimation of moose abundance should be adopted. However, Thompson (1979) proposed a variation of the transect method that overcomes some of the difficulties with past transect methods.

Aerial surveys in which quadrats were exhaustively searched were first introduced in the 1950's (Cumming 1957, Trotter 1958, Lumsden 1959). Quadrat sampling tends to produce higher estimates of moose numbers than transect methods. For example, Evans et al. (1966) and Lynch (1971) found transect surveys provided population estimates of only 25 and 67%, respectively, of estimates obtained by the quadrat method. Using the quadrat sampling technique, each randomly selected plot is thoroughly searched until the observer is satisfied that further searching will not reveal additional moose. The increased counting effort per unit of area both increases the percentage of moose seen compared with the transect method and accounts for the higher and more accurate population estimates. This method assumes all moose are seen in a quadrat, although some animals are inevitably missed. The number of undetected moose varies according to the density of canopy cover, environmental factors, moose behavior, and pilot/observer effectiveness (LeResche and Rausch 1974).

Because sightability of moose was less than 100%, we tested aerial search patterns and intensities in search of combinations which would provide high sightabilities under varying conditions. These search patterns and sightabilities were then used in the development of population estimation procedures. Our sampling design was a modification of the stratified, random sampling procedures reported by Siniff and Skoog (1964) and Evans et al. (1966). Linear transect sampling methods were rejected because they were not adaptable to specific terrain and habitat types in Alaska.

Findings from our research (Gasaway 1977, 1978, 1980; Gasaway et al. 1979) were used to produce a preliminary technique manual for the estimation of moose population size (Gasaway et al. 1981). Workshops have been used to introduce biologists to this survey method.

OBJECTIVES

To develop sampling procedures for estimating moose abundance, and to evaluate moose survey methods presently employed.

To quantify the sightability of moose in relationship to habitat, environmental factors, diurnal and seasonal behavior patterns, sex, age, and aggregation size, and to calculate sightability correction factors for variables when appropriate and/or minimize the influence of variables in the design of survey methods.

To demonstrate the relationship of search intensity to numbers and sex and age composition of moose seen so biases in observed sex and age ratios can be interpreted and minimized.

To prepare a manual describing the application of the population estimation method and the calculation of population parameters, and to assist game biologists in application of survey techniques through workshops and field training programs.

STUDY AREA

The study area was diverse and represented most habitat and terrain types used by moose in interior Alaska. Included are mountains, mountainous foothills, rolling hills, flats, and seral shrub, forest, and subalpine habitats. Botanical descriptions of habitat types were reported by Coady (1976) and include alpine, herbaceous, low shrub, tall shrub, deciduous, and coniferous types. The study area includes drainages of the Chena and Salcha Rivers in Game Management Unit (GMU) 20B and much of GMU 20A.

METHODS

Methods used to estimate sightability of moose and develop the sampling scheme have been described in previous reports (Gasaway 1977, 1978, 1980; Gasaway et al. 1979).

RESULTS AND DISCUSSION

The survey procedure manual in last year's final report (Gasaway et al. 1981) is being rewritten and expanded in preparation for a ADF&G technical bulletin. Manual completion has been delayed because of unsuccessful attempts in finding a method of calculating a variance that estimates the combined sampling error from among sample units and the sightability estimate. We anticipate having a solution by August 1982 and the technical bulletin completed by the end of 1982.

Two survey procedure workshops were held during the year. The 1st in Whitehorse, Yukon was hosted by the Yukon Game Branch and was attended by 30 people from 2 territories and 3 provinces. The 2nd workshop was held in Anchorage for Regions I and II staff.

Moose population estimates were completed or attempted in several areas in winter 1981-82. The Yukon Game Branch completed 3 population estimates. In Alaska, an estimate was made for a 7,772 km^2 area of GMU 20E. An attempt was made in a portion of GMU 20B and D, but strong winds accompanied by deteriorating snow conditions precluded completion. Inadequate snow cover in Units 9 and 17 prevented planned surveys from being started.

The study of sightability and bias during surveys in the snow-free periods was completed and submitted to Canadian-Field Naturalist. Its abstract is in Appendix A. The results were presented at the Alaska Interagency Moose Meeting.

Final analysis of sightability and bias during winter surveys continued. During the past year, all data were entered into a computer and analyses begun. Preliminary results of these data are found in Gasaway et al. (1979).

RECOMMENDATIONS

A manual for estimating moose demography from aerial surveys should be prepared during the next year. Analysis of sightability data should be completed and written for publication. Workshops should be continued so personnel can learn methods for making population and composition estimates. The method should be applied when population estimates and representative composition data are needed for management and research.

ACKNOWLEDGMENTS

We thank Joann Barnett and Wayne Regelin for reviewing a draft of this report.

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APPENDIX A

Bias in Aerial Transect Surveys for Moose During May and June

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Abstract. Biases that affect estimates of population size, trend and composition, and Moose behavior during aerial transect surveys in May and June were identified. Sightability of Moose was 36% in May and 26% in June. Low and variable sightability of Moose preclude making accurate and precise population estimates and prevent detection of population trends without large changes in population size. Sightability of Moose varied widely with habitat type used, activity, and group size; therefore, reliable estimates of these parameters cannot be obtained from Moose seen on aerial surveys during the snow-free period. Differential behavior among sex and age classes of Moose produced bias in a predictable direction for estimates of population sex and age composition. Prior to calving in May, yearling:cow ratios were overestimated. During June, calf:cow ratios were underestimated, and bull/cow ratios were overestimated. We concluded that bias in aerial surveys could be reduced by a substantial increase in search effort, but this increase would probably make the cost of surveys prohibitively expensive.

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: William C. Gasaway and Stephen D. DuBois

Project No.: ~~W-21-2~~ W-22-1   Project Title: Big Game Investigations

Job No.: 1.26R   Job Title: Movements of Juvenile Moose

Period Covered: July 1, 1981 through June 30, 1982

SUMMARY

Dispersal of subadult moose was investigated in a low-density population in interior Alaska. Fieldwork was completed in May 1981. During the past year, a computerized system to analyze home range data was partially developed. It will be completed in 1983 along with the final report for this job.

Key words: Alaska, *Alces*, dispersal, moose, movements.

CONTENTS

BACKGROUND

Dispersal from a moose (Alces alces) population can alter the management strategy for that population and adjacent populations receiving dispersing moose. Therefore, it is useful to predict when dispersal may occur, which sex and age classes are prone to disperse, and what magnitude of dispersal is likely.

Expansion of moose range through dispersal has been documented in North America (Houston 1968; Mercer and Kitchen 1968; Peek 1974a,b; Coady 1980), the Soviet Union (Likhachev 1965; Yurlov 1965; Filonov and Zykov 1974), and Europe (Pullainen 1974). In those studies for which age-specific dispersal was determined, yearling and 2-year-old moose dispersed more frequently than adults (Likhachev 1965; Houston 1968; Peek 1974a; Roussel et al. 1975; Lynch 1976). Adult bull and cow moose were relatively faithful to previously established seasonal home ranges (Houston 1968; Goddard 1970; Berg 1971; Saunders and Williamson 1972; Phillips et al. 1973; LeResche 1974; Coady 1976; VanBallenberghe 1977, 1978). Therefore, the fidelity that adult moose have toward their home ranges minimizes their role in the colonization of new ranges through dispersal.

Dispersal of moose appears to be associated with relatively high population density (Likhachev 1965; Yurlov 1965; Houston 1968; Filonov and Zykov 1974; LeResche 1974; Peek 1974a,b; Irwin 1975; Roussel et al. 1975; Coady 1980). Although not specifically stated by most of the above authors, the densities of moose populations from which dispersal was recorded may have approached or exceeded the carrying capacity of the range based on our interpretations of information presented in those studies. Dispersal from a moose population that was clearly at low density relative to carrying capacity was found only by Mercer and Kitchen (1968).

Many moose populations in Alaska are at low densities relative to the carrying capacities of their ranges. Management of moose should consider dispersal patterns of moose in low-density populations as well as in populations with densities closer to carrying capacity.

This study investigated the frequency, direction, and distance of dispersal as well as the age and sex of dispersing moose in a low-density moose population. The population selected for study had a peak density of approximately 0.8-0.9 moose/km during the mid-1960's (Bishop and Rausch 1974); however, reappraisal of data suggests the density may have been nearly twice the 1st estimate. During the mid-1960's, heavily browsed vegetation and winter die-offs suggested these moose exceeded the carrying capacity of the range. Density had declined to approximately 0.2 moose/km by 1975 as a result of severe winter weather, malnutrition, high harvest by hunters, and high rates of wolf (Canis lupus) predation (Bishop and Rausch 1974; Gasaway et al. 1979). Following harvest reductions since 1975 and wolf control since 1976, this population has steadily increased through 1979. The mean density of moose in the study area had increased to an estimated 0.27 moose/km by fall 1978 (Gasaway et al. 1979), and it is still considered to be below carrying capacity.

OBJECTIVES

To determine how consistent seasonal home ranges of moose are among years, and whether juvenile moose adopt the movement pattern of their dams, and to use these data to design trend count areas.

To determine the extent to which young adult moose contribute to breeding groups other than the ones in which they were produced.

To determine if yearling and young adult moose produced in rapidly increasing populations contribute substantially to adjacent declining populations through emigration, thereby reducing the predation burden on declining populations.

To determine the extent to which rapidly increasing populations can provide hunting recreation in adjacent areas as a result of emigration of young moose.

STUDY AREA

The study area in interior Alaska was described in Gasaway et al. (1981).

METHODS

Methods were described in Gasaway et al. (1981).

RESULTS

Work during this segment was limited to developing a computerized system for analysis of home range and movement data in conjunction with the Susitna dam project and SuzAnne Miller. We have used a small data set (a cow moose and 2 of her independent offspring) to test various methods of analysis. We have not devised completely satisfactory methods yet; however, we do plan to complete the method development, analysis, and write-up during the coming year. At that time, a full discussion of methods and results will be made. A preliminary report is found in Gasaway et al. (1980).

RECOMMENDATIONS

Continue analysis of dispersal data and preparation of a manuscript discussing the results.

ACKNOWLEDGMENTS

We thank SuzAnne Miller and Danny Anctil for assistance with computer program development and Joann Barnett and Wayne Regelin for reviewing a draft of this report.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: William C. Gasaway and Stephen D. DuBois

Project No.: ~~W-21-2~~ W-22-1 Project Title: Big Game Investigations

Job No.: 1.32R Job Title: Impact of Wildfire on Moose Home Range

Period Covered: July 1, 1981 through June 30, 1982

SUMMARY

The response of 7 radio-collared moose to wildfire was investigated to determine if moose were initially displaced from their home ranges. Home ranges of these moose overlapped a 506-km^2 fire that burned from 3 May to 20 June 1980 in interior Alaska. We concluded the radio-collared moose were not displaced by the fire, based on the location of animals from May through August of the 2 years preceding the fire and the year of the fire. Moose selected primarily unburned sites within the perimeter of the fire.

Key words: Alaska, *Alces*, moose, movements, wildfire.

CONTENTS

BACKGROUND

The response of wildlife to wildfire is often perceived as animals fleeing in panic from flames. Numerous examples support this popular concept of animal behavior (Komarek 1969); however, few quantitative data are available to confirm or refute this image as it applies to moose (*Alces alces*) (Kelleyhouse 1979). Some qualitative data do exist, however. Hakala et al. (1971) reported that no moose were observed fleeing from approaching flames during a 348-km^2 fire on the Kenai National Moose Refuge, Alaska. Komarek (1969) claimed large mammals could determine the direction a fire was traveling and usually escape along the sides and flanks, rather than panicking and fleeing ahead of the flames. In contrast, Udvardy (1969, cited in Bendell 1974) reported a more chaotic incident in which moose and other animals swam large rivers to escape a Siberian wildfire.

Moose managers, fire suppression personnel, and the general public need to understand the response of moose to wildfire if "let burn" fire policies and prescribed fires are to become more widely accepted in the North. Following fire, if moose are displaced from their home ranges either permanently or for many years, then moose population regrowth in the area would be dependent upon immigration of moose back into the burn. On the other hand, if moose that traditionally used the burned area remained in their established ranges, they would then contribute substantially to population growth in the burn. In addition, if fire did not displace moose, there would be less concern about the welfare of moose during and after a fire.

OBJECTIVES

To determine effects of wildfire on moose movements during and immediately after the burn; determine if, when, and how moose modify their traditional home ranges after a fire to take advantage of new browse; determine if postfire moose population growth occurs from immigration and/or reproduction; and incorporate findings into Alaska's fire management program so maximal rates of moose population growth can be calculated following fire.

STUDY AREA

The interior Alaska study area is on the lowlands of the Tanana Flats (Fig. 1). The Tanana Flats is a mosaic of habitat types including herbaceous bogs, shrub-dominated seres following wildfires, deciduous forests, and black spruce (*Picea mariana*) and white spruce (*P. glauca*) forests (LeResche et al. 1974).

METHODS

A wildfire in May and June 1980 overlapped the home ranges of 5 radio-collared cow moose and 2 radio-collared bulls. Locations of radio-collared moose from 29 April-August 1980 were compared to locations during 29 April-August of 1978 and 1979 to determine if the fire displaced the moose. Four of the cows had been relocated 8-11 times each during 29 April-August 1978, and all 7 moose were relocated 4-7 times each from 29 April-August 1979. In 1980, the moose were relocated 4-6 times each before and while the fire was burning and 2-5 times each after the fire. In 1980, moose were recorded as being inside or outside the fire perimeter. If inside, the site selected by the moose was recorded as burned or unburned. All relocations were made from fixed-wing aircraft and plotted on 1:63,360 maps. The intensity of the burn, based on criteria of Viereck and Schandelmeier (1980), was assessed during flights over the burn and by several ground observations.

All home ranges were drawn using the minimum home range method (Mohr 1947). We use the term "home range" realizing that we have a very small sample of relocation points for drawing home range polygons. For this reason, we made a subjective visual comparison between the 1978-79 and 1980 home ranges of each moose to determine if displacement had occurred.

The frequency of relocation points occurring inside and outside of the fire perimeter in May-August 1978, 1979, and 1980 was obtained by comparing the date of each relocation point to the chronological advance of the fire perimeter. The advance of the fire was monitored by the Bureau of Land Management and the Alaska Department of Natural Resources, Division of Forestry. Chronological advance of the fire's perimeter was drawn on 1:63,360 maps.

RESULTS

A 506-km^2 wildfire burned on the Tanana Flats from 3 May-20 June 1980. The fire burned predominantly mature black spruce and aspen (*Populus* spp.) forest, which supported a low moose density. In the portion of the burn used by the radio-collared moose, about 75% of the area was moderately to severely burned, about 10% lightly burned, and about 15% unburned. Basal sprouting of many willows (*Salix* spp.) occurred during summer 1980.

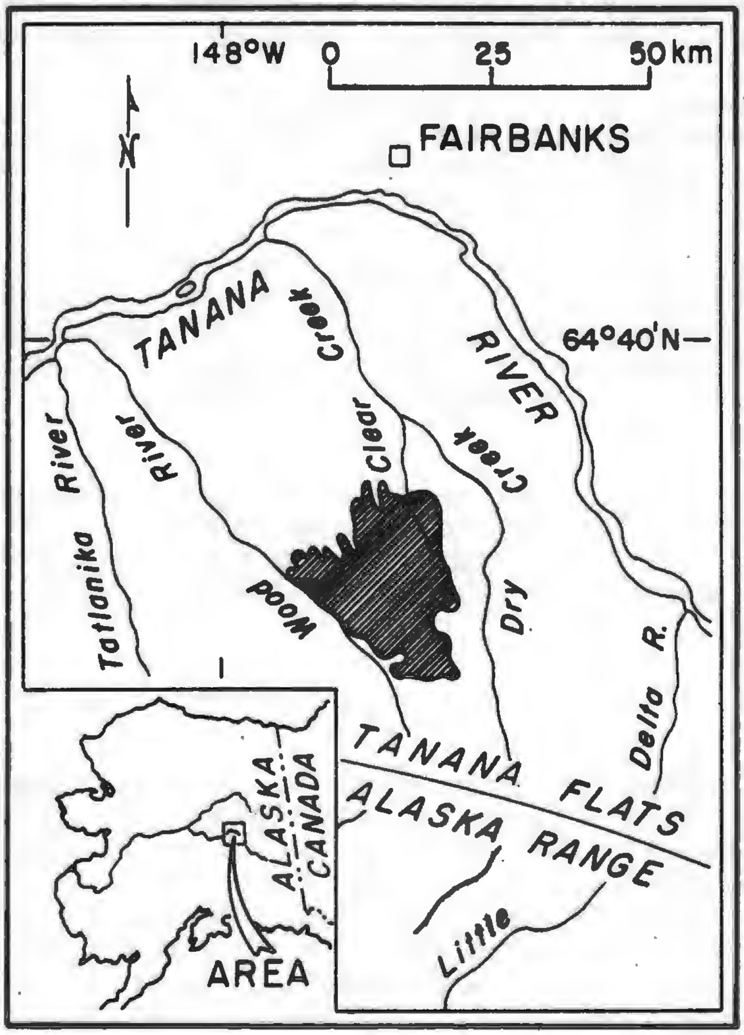

Fig. 1. Location of the 506-km^2 wildfire (shaded area) that burned on the Tanana Flats, Alaska from 3 May–20 June 1980.

Approximately 40% (range 20-75) of the area in each home range was outside the fire perimeter.

The fire did not displace moose from their established home ranges. We found no substantial variation between prefire home ranges and home ranges during and after the fire (Figs. 2 and 3); each moose had a large amount of overlap in home range between years. In addition, we detected no evidence of displacement based on the number of relocation points inside and outside the fire perimeter between 1978-79 and 1980. Twenty-six percent of the 1978-79 relocation points were inside the fire perimeter compared to 53% during 1980 (Table 1).

Moose showed no reluctance to use that portion of their home range within the fire perimeter, even while the fire was burning and producing dense smoke (Fig. 4). Fifty percent of all June 1980 relocation points were inside the fire perimeter (Table 1), and on 2 occasions, moose were seen standing within 5 and 50 feet of small flames.

When moose were within the perimeter of the burn, they showed strong selection for unburned vegetation. Although only approximately 15% of the vegetation remained unburned, radio-collared moose were located in unburned sites 67% (N = 30) of the time.

DISCUSSION

Moose were not displaced from their traditional home ranges when a portion of their range was altered by fire. Unburned vegetation apparently met their food and cover requirements and may have been the main factor enabling them to remain within their ranges. Unburned vegetation was available outside the fire perimeter and as islands inside the fire perimeter; moose used both sources (Fig. 4). Additionally, moose browse began to resprout in the burned area during summer 1980.

Data in Table 1 appear to indicate that moose were attracted to the burn area during June and July 1980, but we hesitate to draw this conclusion. Nonsystematic sampling may have resulted in 1 or more moose being relocated a disproportionate number of times while inside the fire perimeter during 1980. Movements of each moose showed no clear shift of home range into the burn during 1980 as compared with other years.

Wildfires in interior Alaska commonly burn mature or climax forests, which generally have low moose densities; therefore, few moose will be associated directly with wildfires. Moose that are in contact with a wildfire may not be adversely affected and will probably remain in their home ranges to provide breeding stock, if adequate food and cover remain unburned and resprouting

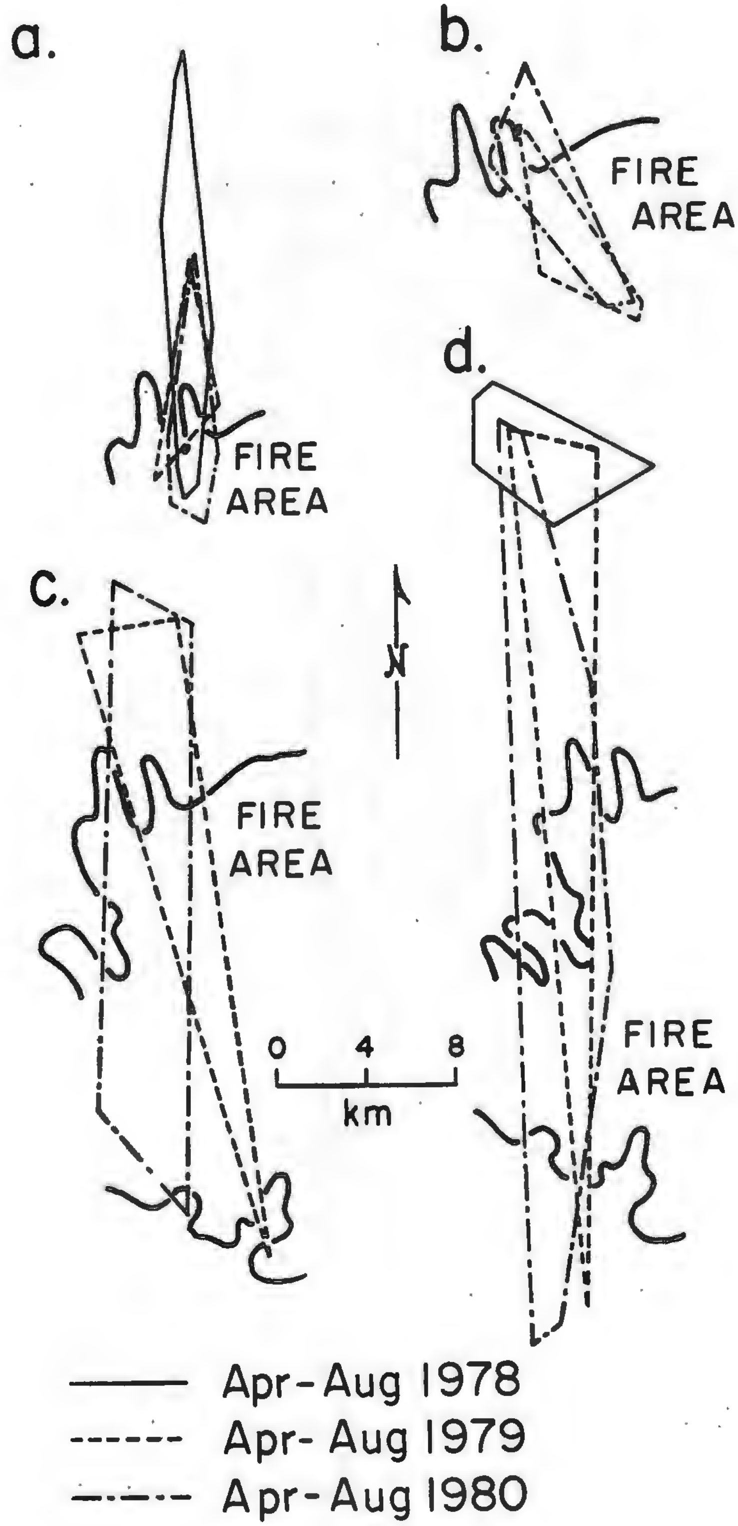

Fig. 2. Home ranges of 4 radio-collared moose for 29 April-August 1978, 1979, and 1980 in relation to a wildfire that burned from 3 May-20 June 1980 on the Tanana Flats, Alaska.

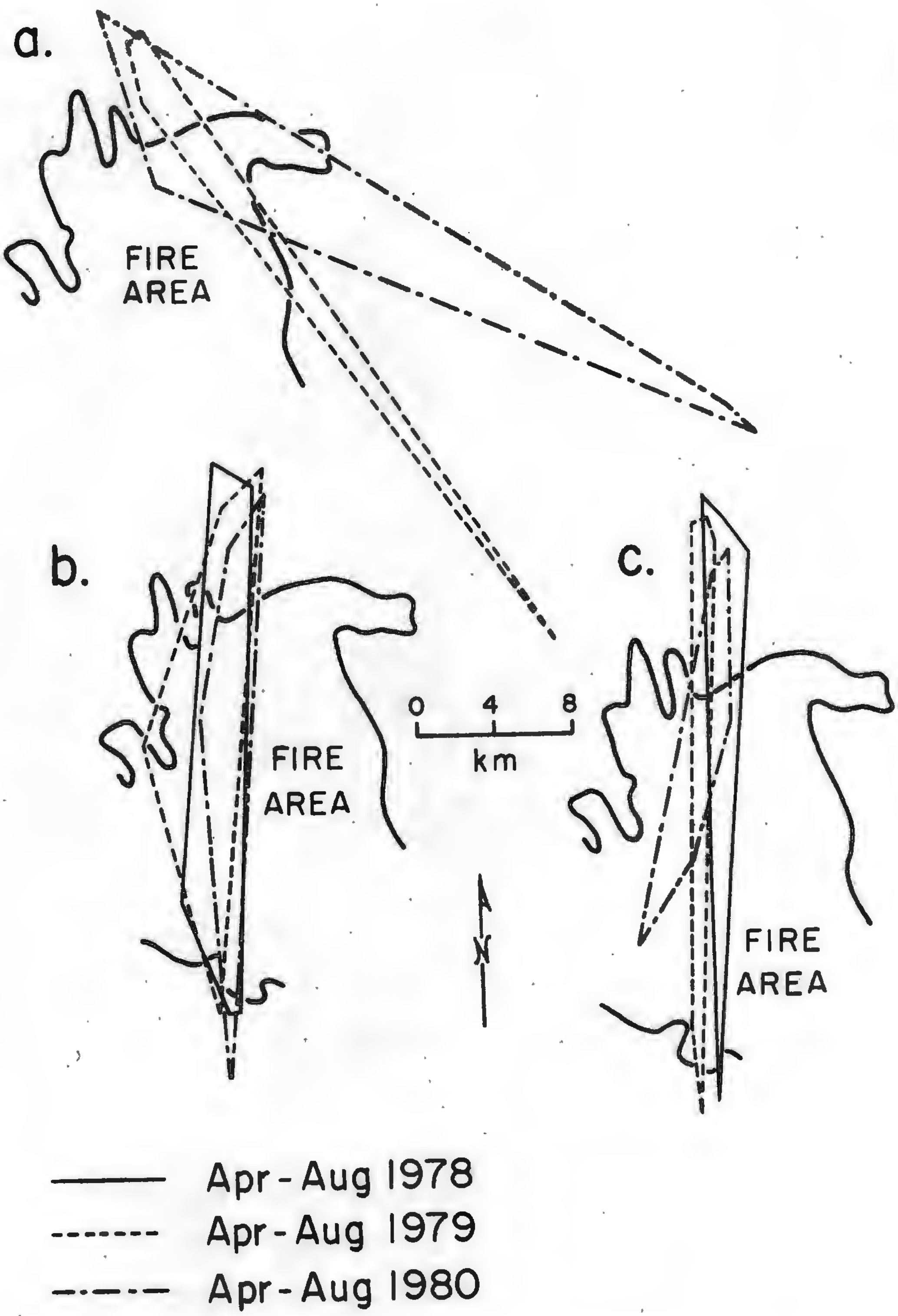

Fig. 3. Home ranges of 3 radio-collared moose for 29 April-August 1978, 1979, and 1980 in relation to a wildfire that burned from 3 May-20 June 1980 on the Tanana Flats, Alaska.

Table 1. Percentage of relocation points within the fire perimeter for 7 radio-collared moose during May-August 1978-79 (prefire) and May-August 1980 (year of the fire) on the Tanana Flats, Alaska.

Month	Status of Fire	1978-79 N	1978-79 %	1980 N	1980 %
May	Burning	37	11	11	9
June	Burning	17	12	20	50
July	Out	6	17	8	75
August	Out	8	63	9	78
Mean		68	26	48	53

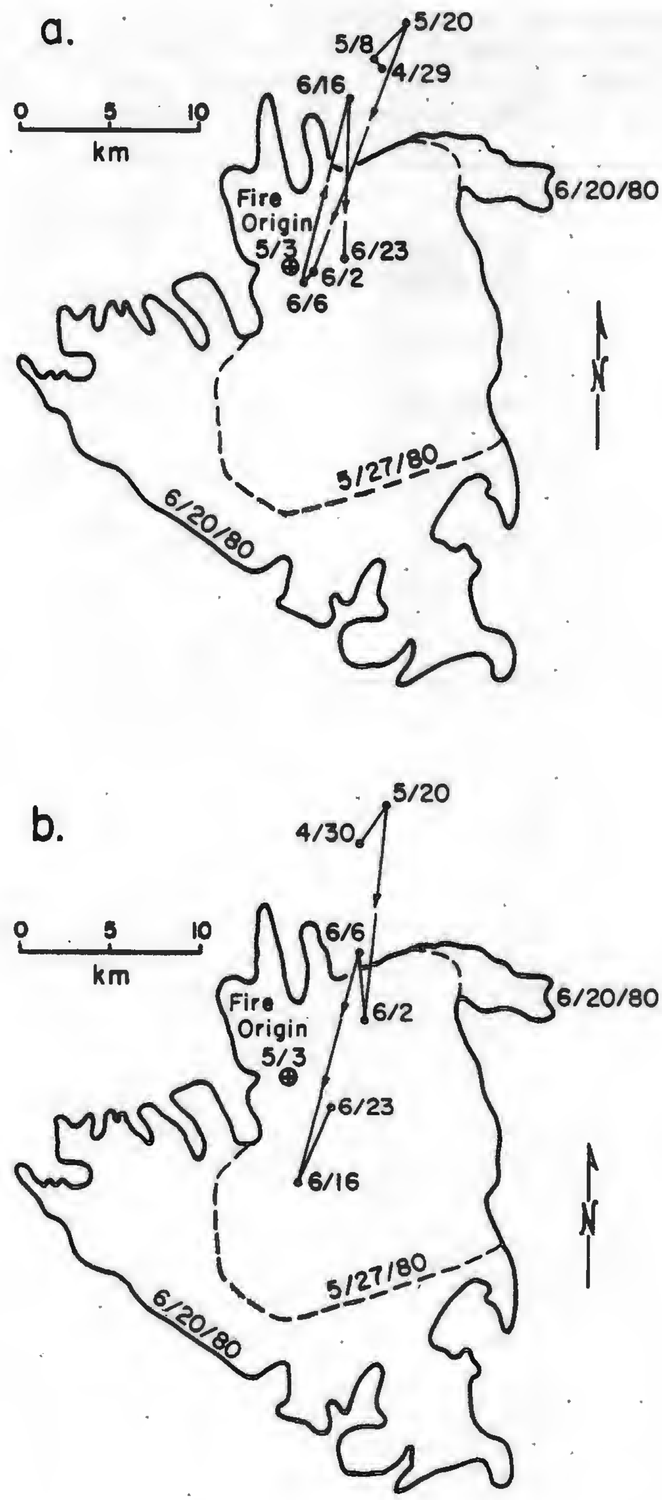

Fig. 4. Movements of 2 radio-collared moose from 29 April-23 June 1980 in relation to a wildfire that burned from 3 May-20 June 1980 on the Tanana Flats, Alaska. Intermediate (dashed line) and final fire perimeter (solid line) are shown.

rapidly occurs. Wildfires that burn hotter, leave fewer unburned inclusions, and advance faster than the fire we studied may force moose to abandon their home ranges. Therefore, when planning prescribed burns or managing a wildfire to benefit moose, the best burn strategy for moose population growth is the retention of an adequate supply of unburned moose habitat for resident moose.

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