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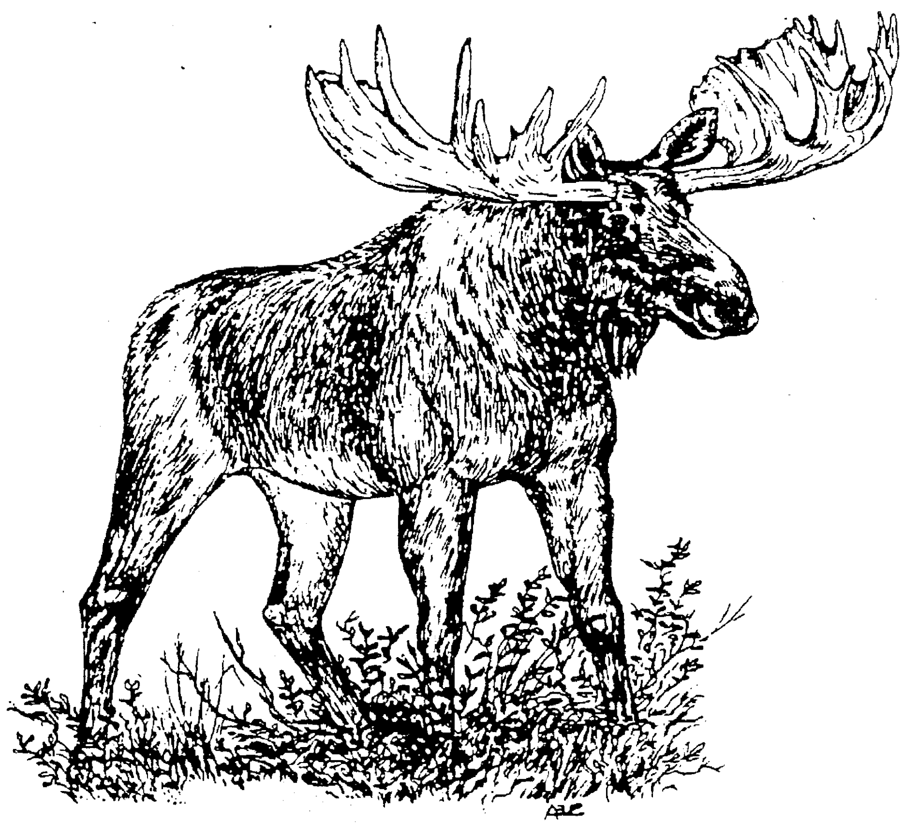
Ecology of Moose in the White Mountains National Recreational Area, Alaska, 1985–88

Winston Hobgood and Bruce M. Durtsche



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INTRODUCTION

The White Mountains National Recreation Area (WMNRA), containing approximately one million acres of public lands, was established by the Alaska National Interest Lands Conservation Act in 1980. The same act established the upper portion of Beaver Creek as a component of the National Wild and Scenic River System. Public land policy for administering public lands became public law in 1976 as the Federal Land Policy and Management Act. ANILCA mandated land use plans for designated areas and maintained options to explore and develop locatable minerals pursuant to the Mineral Leasing Act of 1920 as amended and supplemented.

This study of the ecology of moose in the WMNRA was initiated in cooperation with the Alaska Department of Fish and Game (ADF&G) in 1984 to document and map moose habitat information and moose movements, distribution and use areas. These data will be used in the future to measure existing and potential impacts from wildfire, recreation, mining and other uses of the public land. The study is a supplement to BLM's Steese/White Mountains Master Habitat Management Plan, and answers one of that plan's objectives: to document crucial use areas and movements of moose. The study will also provide relevant information for the implementation of ADF&G's management goals for this area.

Moose provide both consumptive and nonconsumptive uses to recreationists using the Beaver Creek National Wild and Scenic River and the WMNRA. Moose-related float trips for recreational viewing, photography and hunting are believed to involve 30% to 50% of all float trips on Beaver Creek (Tom Dew, pers. comm.).

The moose population in the Beaver Creek area was low in the early 1980s because of poor calf survival in the summers (Nowlin 1987). Current and past high calf mortality appears to be caused by bear and wolf predation. Approximately 400 moose observed during a 1985 survey of upper Beaver Creek indicated a population stabilization following the downward trend of previous years. Very little is known about moose population characteristics and habitat utilization in the Beaver Creek watershed.

Phase I of this study examined habitat use by the moose and their distribution and movements. Phase II assesses the effects of fire on moose habitat, movements and population dynamics.

STUDY AREA

The Beaver Creek watershed and the WMNRA are located about 50 air miles north of Fairbanks (Figure 1). The majority of the watershed lies within the Yukon-Tanana Uplands physiographic province, which consists of rounded hills around a high central area of rugged mountains (Selkregg 1974).

The highest point in the study area is Mount Prindle (5,286 feet), on the south-eastern border of the drainage. Other notable high points are Rocky Mountain

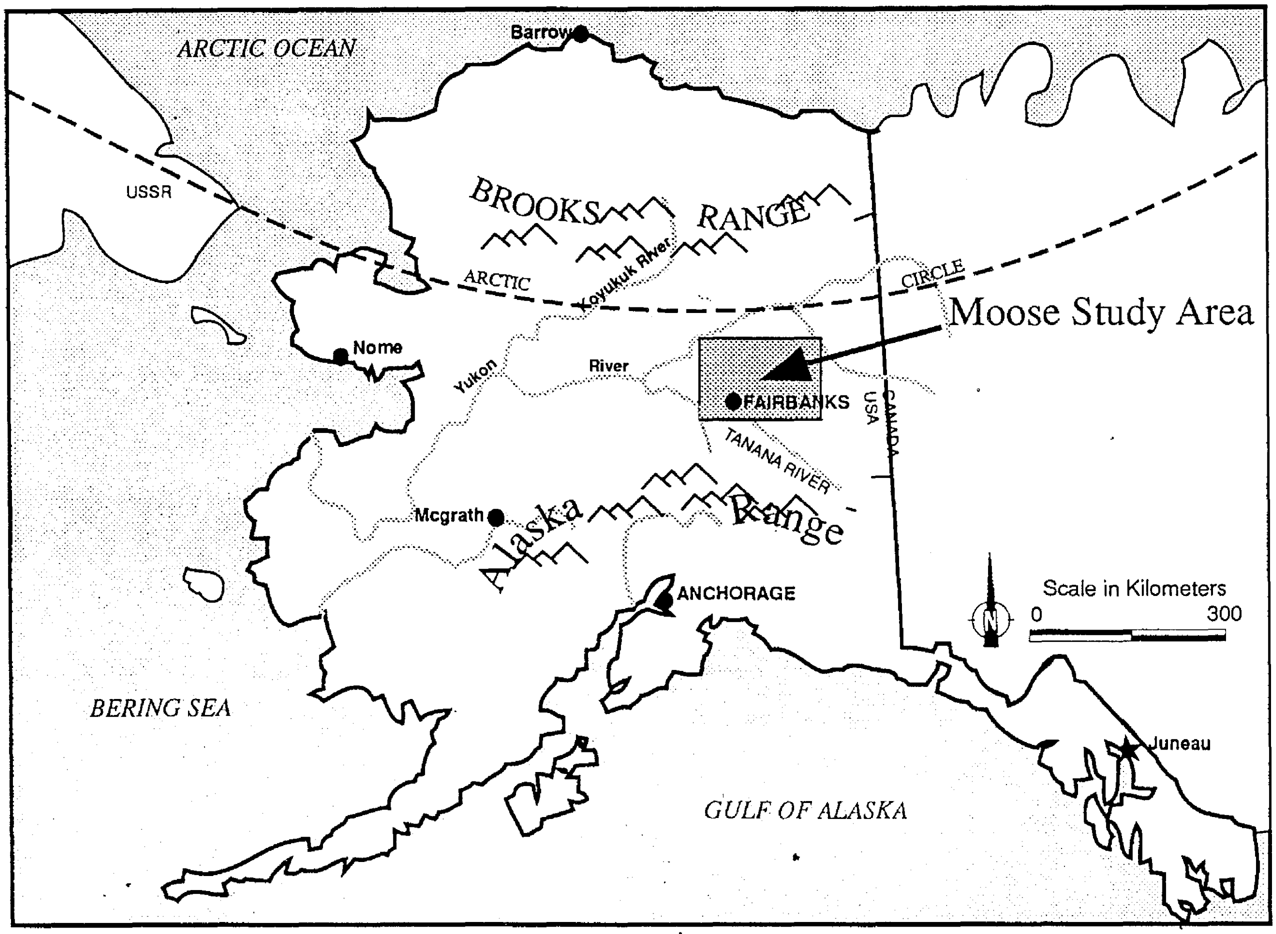


Figure 1. Area Map

(5,082 feet, formerly known as Lime Peak), Cache Mountain (4,772 feet), Victoria Mountain (4,588 feet), Mount Schwatka (4,177 feet) and Wickersham Dome (3,207 feet). The lowest point in the study area, approximately 600 feet, is on the northern edge of the Yukon Flats.

Beaver Creek forms at the confluence of Champion and Bear creeks in the southeast portion of the study area. Beaver Creek, from Bear Creek to the Yukon River, is 303 miles long. Only the first 127 miles are designated as wild. About 111 miles of upper Beaver Creek are in the WMNRA. Other important streams are Nome, Quartz, Colorado, Wickersham, Fossil, Trail, O'Brien and Victoria creeks.

The Beaver Creek area climate is typical of interior Alaska with cold, dry winters and warm, short summers. The mean January temperature is minus 20° F to minus 30° F. The mean July temperature is about 70° F and may reach as high as 95° F. Precipitation averages over 11 water-equivalent inches per year, including 70 inches of snow during autumn, winter and spring.

OBJECTIVES

Study objectives are:

1. Determine distribution, movements and use areas.
2. Determine seasonal habitat preferences.
3. Determine numbers, composition, productivity and mortality.
4. Implement habitat improvement by prescribed burning and natural burns; monitor effects on habitat.
5. Use results to identify crucial use areas and timing as well as to predict impacts and develop measures to avoid or mitigate adverse effects of mineral exploitation, development and other factors.

METHODS

Areas in the WMNRA were selected for browse improvement by burning, either by naturally occurring wildfire or by planned ignition. The selected areas had homogeneous climax vegetation cover or were low in available moose browse. Burn control considerations were an important aspect in determining suitable areas. Prescribed fire was ignited by dropping fusees from a Bell 206 helicopter. Natural fires were allowed to burn in areas where moose browse could be increased and the fire did not threaten life or property in accordance with the Tanana-Minchumina Alaska Interagency Fire Management Plan.

Moose were captured using a Bell 206B or Hughes 500D helicopter and a Cap-Chur dart gun with standard capture techniques previously used by ADF&G. A PA-18 fixed-wing aircraft was used to locate and guide the helicopter to candidate moose. The airplane also observed sedated and recovering animals and communicated their location and condition to the helicopter. M99 (Etorphine: ten mg dosage) was used intramuscularly for immobilization. M50-50 (Diprenorphine: 20 mg dosage) was injected intramuscularly or intravenously for recovery. Orange vinyl-covered canvas was riveted to Telonics, Inc., radio collars to increase visibility in the field.

Monitoring surveys to relocate collared animals were flown in fixed-wing aircraft (PA-18, C-180 and C-185). Surveys were flown 1 or more times every 2 weeks between April 1 and October 31 and 1 or more times monthly between Nov. 1 and March 31, 1984 to 1988.

Relocation survey information included location, presence of calves, group size, vegetation, sex and incidental observations. Information was recorded on preprinted data forms and USGS quadrangle maps of 1:63,360 and 1:250,000 scale. After survey flights, location data were transferred to 1:63,360 scale USGS maps for later analysis.

RESULTS

Prescribed Fire

One objective of the Beaver Creek Moose Study is to study the enhancement of moose habitat by prescribed burning and allowing natural fires to burn in selected areas. Fire has been shown to improve the quantity, quality and availability of moose forage (LeResche et al. 1974 ; Spencer and Hakala 1964). Under present fire management policy, three natural fires and one prescribed fire burned about 71,000 acres in the WMNRA in 1987 and 1988. A planned fire in 1987 burned about 2,000 acres in the upper Bear Creek area before being extinguished by rain. A natural fire burned about 40,000 acres in the Brigham-O'Brien creeks area in summer 1987. In 1988, the 500,000+ acre Livengood fire burned about 15,000 acres of BLM-managed lands near Victoria Creek.

Radio-collaring

Twenty-three individual moose have been radio-collared to date. Of these, 3 were males and 20 were females. Twelve moose were captured and collared on April 14 and15, 1985. On November 4, 1987, 7 previously collared moose were recollared (Table 1). Eleven new moose were collared on March 23, 1988. Between April 19, 1984, and June 1, 1989, 129 flights resulted in 961 relocations.

The study team's primary goal for collaring was to capture females so it could better determine rut areas, calf production, calving areas and causes of calf mortality. Two males were also captured in 1985. In March 1988, the team decided to collar 1 of 2 calves born to female #430, hoping it would be female. Female 430 was known to move long distances to her calving area and to her summer range. Data from her offspring would provide useful information about learned migratory habits. However, both calves were males; one was radio-collared in lieu of a female.

Ages, determined by tooth sectioning, of 10 moose (9 females and 1 male) captured in 1985 averaged 5.2 years. Ages of 6 moose captured in late 1987 and early 1988 averaged 7.1 years. A t-test comparing those means showed no significant difference. The average age of all moose (16) now wearing collars is 7 years.

No mortality resulted from the collaring process. During collaring in November 1987, two calves associated with cows that were collared ran away during darting/ collaring. One calf was subsequently found with its mother 2 weeks later. The other calf was never seen with its mother again, implying capture-induced separation. Considering the age of the calf (6 months), its survival was doubtful.

Movements

Predictible and repetitive movement patterns of all moose collared in 1985 (Figure 2) have been established. WMNRA moose cows either moved out of the Beaver Creek watershed to calve or they remained there to calve. In late summer all moose cows moved at least a short distance for the rut. General movement pat-

Table 1. Dates collared, dates recollared, frequencies, sex, age, date of death or loss of contact and pertinent notes of radiotelemetered moose in the WMNRA, 1985-1988.

Date Collared	Sex/Age (Yrs)	Freq.	Recollared	New Freq	Found Dead	Collar Out	Notes
4/18/85	F/8	851	3/23/88	460			
4/18/85	F/7	505	3/23/88	470			
4/18/85	M/2	495					
4/19/85	M/3	872			9/1/86		
4/19/85	F/11	831	3/23/88	430	10/15/88		
4/19/85	F/?	486	3/23/88	280			
4/19/85	F/7	516	3/23/88	440			
4/19/85	F/3	526					
4/19/85	F/3	881	3/23/88	1660			
4/19/85	F/3	547				11-86	last located date 11/86
4/19/85	F/?	536					
4/19/85	F/5	841	3/23/88	980			
11/4/87	F/?	180					
11/4/87	F/?	60					
11/5/87	F/?	262					
11/5/87	F/?	250					
11/5/87	F/?	12					
11/5/87	F/?	53					
11/5/87	F/?	40					
11/5/87	F/?	292					
11/5/87	F/?	190					
3/23/88	F/Calf	270			5/9/88		Calf of #526
3/23/88	M/Calf	210			9/5/88		Calf of #831

terns of moose collared in late 1987 and early 1988 are evident, but more locations are necessary to clarify details and solidify the results.

Distance

Twenty-two moose utilizing the Beaver Creek watershed fell into 3 movement categories:

1. moose that moved to and from the Fairbanks area,

2. moose that moved to and from the Minto Flats area, or

3. moose that remained in the general area (WMNRA) in which they were captured.

The 22 moose were almost equally divided among the 3 groups with 8 in the first group and 7 each in the second and third groups.

Eight collared moose make an annual trek at spring breakup from the White Mountains to the Fairbanks vicinity. In 1988, this group comprised almost 40% of the living collared moose in the WMNRA. The distance traveled between summer and winter range averaged 49 miles, with the moose traveling between 40 and 60 miles (Table 2). These moose spread out over an area from Ester to North Pole, a distance of approximately 50 miles. Most moose remained on the north side of the Tanana River, except 1 moose that ventured across the Tanana on 2 occasions.

One moose occupied an established use area about 6 miles outside the WMNRA, near Twin Buttes, in mid-to-late summer and in late winter. It spends the remainder of the year in upper Beaver Creek.

Documented travel routes (Figure 2) of moose regularly moving into the Fairbanks area are:

1. across the Steese Highway near Twin Buttes to Kokomo Creek, down the Little Chena River to the Chena/Tanana Flats. This appears to be a major route.

2. across the Tanana Hills near Cleary Summit, down Steele Creek (Esro Road) to Columbia Creek/Birch Hill area.

3. Vault Creek (possibly via Trail Creek or Wickersham Creek) near Olnes to Goldstream Creek to Emma/Cripple Creek area.

Another group of 7 moose moved from their winter range in upper Beaver Creek to the Tatalina River below the Elliott Highway and as far into Minto Flats

Table 2. Summary of seasonal use areas and distances traveled (linear miles) by moose radio-collared in the Beaver Creek drainage of the WMNRA, 1985-1988.

Frequency	Summer use area	Winter use area	Distance traveled
250			25
262			60
053	Tatalina River	Beaver Creek	30
292	Minto Flats		28
012	(west)		25
505			45
881			25
190			45
210	Fairbanks vicinity	Beaver Creek	40
831	(south)		58
060			40
180			50
536			64
486			40
547			less than 25
875			"
040			"
526	Beaver Creek	Beaver Creek	"
841			"
516			"
851			"
495			"

as the old Dunbar Trail. Their movements ranged from 25 miles to 60 miles, averaging 34 miles. Access routes following the Tatalina River and Globe Creek were documented.

An analysis of recent locations indicates that 2 moose in this group occupy a range in the upper Tatalina drainage, moving into upper Beaver Creek during the rut and returning to the Tatalina in January.

The last group of 7 moose has remained in the Beaver Creek watershed since collaring. One of these moose traveled about 25 miles on one occasion and returned shortly thereafter.

Summer/Early Fall

After cows had made their spring movements, most of them delivered calves in late May or early June and remained in the general calving area until July or early August. By late August or early September, most cows had usually arrived in the general area where they would breed that year. Data indicate that each cow demonstrated a high degree of fidelity in returning to specific drainages and specific locations within the drainage in the course of annual activities. They were often located in almost the same spot, on the same date, year after year.

Winter

Once cows arrived in breeding areas, by mid-September at the latest, they would remain there until the rut was over in December. By January, cows that had moved to a breeding area had returned to their respective wintering areas for the remainder of the winter. They remained there until they moved to calving grounds in April or May.

Use Areas

Major moose use areas found in this study are delineated in Figure 2. Evaluation of results indicates that moose movement data may be affected by selection of moose to be collared in terms of location and timing of collaring. If moose had only been collared during midwinter or late winter, some moose that lived primarily outside the WMNRA would have been overlooked. Conversely, some moose probably move outside the WMNRA during the rut. If moose had been collared only during summer, the team would probably have been unaware of moose that moved outside the area to calve. It was tempting to collar a larger portion of moose from large rut aggregations. This would have resulted in an over-representation of moose from specific use areas in this study. Later it became appparent that the location and timing of collaring had a large influence on resultant movement and use area data. Overall, it appears that the best time to collar a representive sample of moose utilizing a given area is during breeding season.

Winter

Collared moose moved to lower elevations in December and January after the rut. At these lower elevations, roughly 1,000 to 2,000 feet, they concentrated in riparian habitat along Beaver Creek and drainages feeding into Beaver Creek.

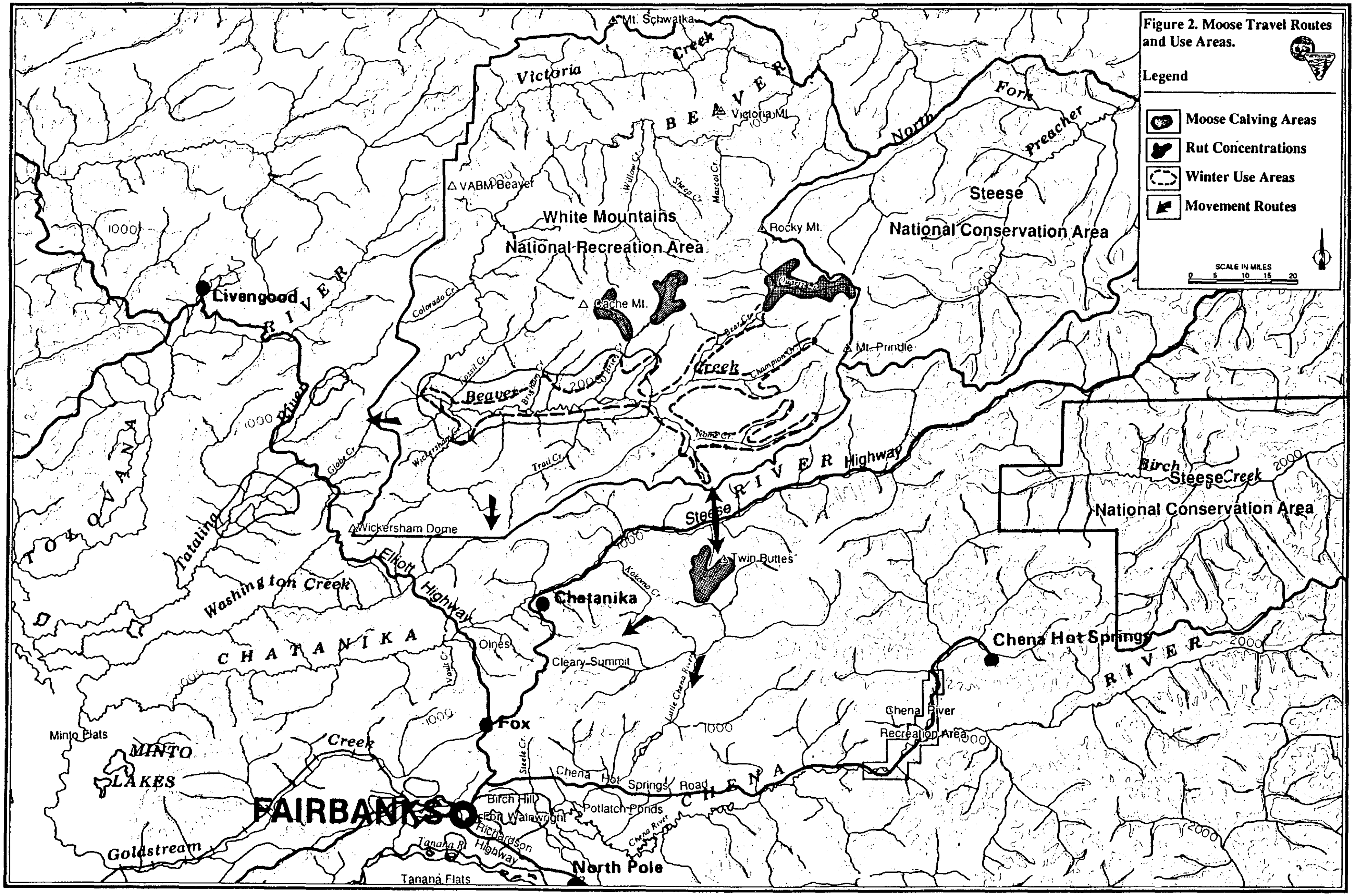


Figure 2. Moose Travel Routes and Use Areas.

Moose primarily used feeder drainages that had southern exposures and good willow stands. Moose that had moved into Beaver Creek from surrounding areas, such as Twin Buttes to the south or the upper Tatalina to the west, returned to those home areas.

Spring/Calving/Summer

Moose remaining in the Beaver Creek corridor or adjacent drainages moved away from the river to calve, often to a brushy secondary or tertiary tributary. Calves were born about 1/4 to 1/2 mile off the river or creek in thick shrub/black spruce habitat. Mother and offspring stayed about 2 weeks in a small area of dense foliage before venturing out into more open woodland or riparian habitat along waterways. They remained in similar habitat until late July or early August, when they began to move to higher elevations.

Seven moose moved into the Fairbanks vicinity in 1988 to calve. In all cases, initiation of movements each year coincided closely with the breakup of Beaver Creek. Specific calving locations near Fairbanks used by collared moose are:

1. the Cripple Creek drainage in Ester,
2. the area between Farmers Loop Road and College Road,
3. the Columbia Creek area between Chena Hot Springs Road (CHSR) and Fort Wainwright,
4. the area between the Little Chena River, Nordale Road and CHSR, and
5. an area on the Tanana River adjacent to the North Pole Refinery.

The Columbia Creek drainage near Fairbanks is comprised of a mosaic of black spruce forest, tussock/shrub tundra, bogs, riparian habitat and dense shrub thickets, and is used by a large number of calving cows and yearlings. This drainage appears to be a very important calving area, While locating collared cows, it became apparent that the entire area between CHSR, Badger Road-Richardson Highway and the Grange Hall Road, as it extends from CHSR to Moose Creek, is crucial habitat for moose from as far away as the White Mountains. During calving season in 1987 and 1988, an estimated 30 to 50 moose were in one small area in the Columbia Creek drainage.

One yearling bull also moved between the WMNRA and North Pole. This bull's mother calved annually on a small island in the Tanana River adjacent to the North Pole Refinery. We were not able to track the cow and her twins during their movements to the calving area in the spring of 1988, but it appears that this yearling and his twin brother moved with their mother. The yearling stopped about 3 miles short of his mother's destination, spending the summer in the vicinity of the Chena Lakes Recreation Area. Presumably, a yearling bull accompanying him in May was his twin.

Collared cows calving or summering in the Tatalina drainage confute the simplicity of previously discussed observations. Whereas moose remaining in the WMNRA and those moving to the Fairbanks vicinity presented straightforward seasonal use patterns, moose moving between the WMNRA and the Tatalina River drainage exhibited variable movement patterns. Of the seven animals monitored that utilized the Tatalina habitat, five were collared in November 1987. Their location information is limited to one year, which may be a factor contributing to the observed aberrations. Three cows moved from the WMNRA to the Tatalina to calve, much like the animals moving to Fairbanks. Two cows spend the summer and winter in the Tatalina drainage and move into the upper Beaver Creek drainage to breed. One cow had twin calves in the Beaver Creek drainage on May 27, 1988, then moved to the Tatalina drainage between June 17-29. The cow and calves remained there until about July 14, when they returned to Beaver Creek. This deviates from other findings in that the move was made soon after calving and the duration of the move was much shorter. Another cow, collared in 1985, also moved to the Tatalina drainage between July 1-15, 1985, and was back on Beaver Creek August 7. She moved again in the latter part of June 1987, and returned to Beaver Creek around July 20. This same cow was also located on March 2, 1987, in the same area and had returned to Beaver Creek by May.

Initially, it was speculated that calving might be the driving force behind these movements. This has been disproved several times, most notably by the bull that moved and additionally by the cows that moved after calving. Three cows moved to the Tatalina in 1988, none were observed with a calf. If any of these cows calved in 1988, their calves disappeared shortly after birth. The previously mentioned cow (that was collared in 1985 and had moved after calving in July 1985 and 1987) also had calves in 1986 and 1988 but didn't move those years. One untested explanation of unpredicted movements, other than forage-related, might be harassment by bears or other predators. Competition for quality habitat when population density is high might be another possible explanation.

Fall/Rut/Early Winter

Moose with widely separate summer and winter ranges returned to winter ranges in July or early August by the same routes they used in spring. Some moose took almost a month to reach winter ranges, stopping along the way for periods of 1 or 2 days to 2 weeks. Presumably, their progress was slowed by the presence of calves. Moves of 10 miles per day by cows with calves were documented.

During the breeding season, bulls and cows were observed along most of Beaver Creek and its tributaries. However, some areas stood out as more important because of either the number of relocations that accumulated there over time, or direct observations of moose concentrations, or both. These areas are shown in Figure 2 on page 8. They have several features in common: southern exposure, open terrain with good visibility, a good supply of willows, on or in hills above 1,800 feet MSL in elevation, and being at or near treeline.

Use of these areas was thought to be regular and predictible—until 1988. From 1985 to 1987, aggregations exceeding 50 moose were routinely observed in the headwaters of O'Brien Creek, the largest observed aggregation of moose in the WMNRA during rut. Over-flights of this particular area of upper O'Brien in fall

1988 resulted in counts of less than 5 moose. More than 30 moose were observed in the Quartz Creek drainage 1985 to 1987. In 1988, however, fewer than 5 moose were seen during an overflight of Quartz Creek during rut.

The most plausible cause of this relatively drastic change in use areas is the 40,000+ acre Brigham Creek fire of 1987. A hot fire consumed most of the vegetation in this area, including standing timber. One year after the fire, the area fit the description of favored areas mentioned above: southern exposure, open terrain with good visibility, a good supply of willows, on or in hills above 1,800 feet MSL in elevation, and being at or near the treeline. It is also adjacent to the heavily used wintering area along Beaver Creek. During the 1988 rut, concentrations of moose were found in uplands adjacent to Brigham Creek. The portion of the burn being used is about 15 miles from the O'Brien headwaters. Further reconnaissance and a study being implemented in the summer of 1989 should provide insight into factors affecting and effecting moose movements.

Mortality

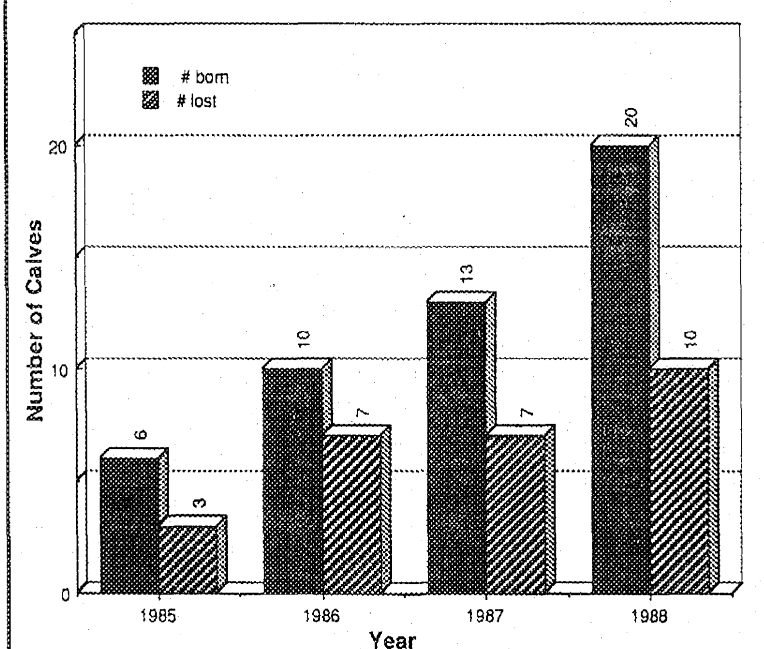
Adults

Four of 26 collared animals have been found dead since this study began in 1985. Two bulls, ages 4 and 1, were killed by hunters. One, a yearling, died of unknown causes in late winter. The fourth animal was a cow found dead at a gravel pit off the Steese Highway. Although the cause of death is unknown, evidence indicated she may have been illegally shot. At least 2 other cases of illegally killed moose were reported in the same area in the same time period. We failed to relocate 1 cow about a year and a half after she was collared. Her collar was not functioning properly at the time of her disappearance and it is assumed the collar failed.

Calves

Twenty-four percent of all calves born during this study disapppeared in June each year, 1985-1988. Disappeared is defined as not being seen again with their mothers and it is assumed that these calves died from unknown causes. Figure 3 shows the number of calves born to collared moose and the number lost by year, 1985-1988. Figure 4 shows the number of calves lost by month for the

Figure 3. Number of calves born to collared cows and number lost, 1985-1988.



same period. Seventy-six percent of the calves lost disappeared in June and July (Figure 4). Figure 5 illustrates that calf loss was relatively stable in 1985, 1987 and 1988, ranging between 46% and 50%. In 1986, unknown factors resulted in a loss of 70%. When the data are broken down by month for each year (Figure 6), it is evident that an inordinate porportion, 60%, of calves was lost in June and July, 1986. June 1986 field notes indicate that 2 collared cows, previously with calves, had long rake-marks on their flanks, appeared upset, exhibited aggressive behavior toward the airplane and were without calves. Bear-cached remains of 2 moose calves were found along a short stretch of Beaver Creek, indicating an unknown number of calves were being killed by bears.

When the mortality data for calves born on Beaver Creek and in the Fairbanks area are separated, some interesting figures surface. Figure 7 shows that 29 calves were born near Beaver Creek between 1985 and 1988. For the same period, 17 calves were born near Fairbanks. Fifteen of 29 calves (52%) born in Beaver Creek disappeared, primarily in June and July. Seventeen calves were born in the Fairbanks area during this same period. None of these calves disappeared. None of the Fairbanks calves disappeared in

Figure 4. Number of calves missing by month, 1985-1988.

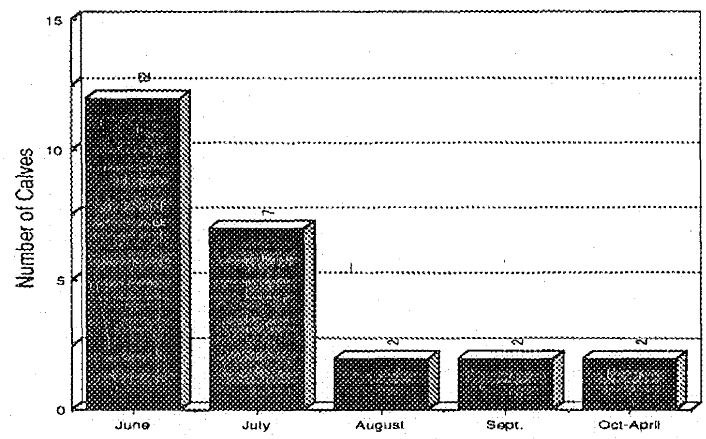


Figure 5. Percent calves lost May-June, 1985-1988.

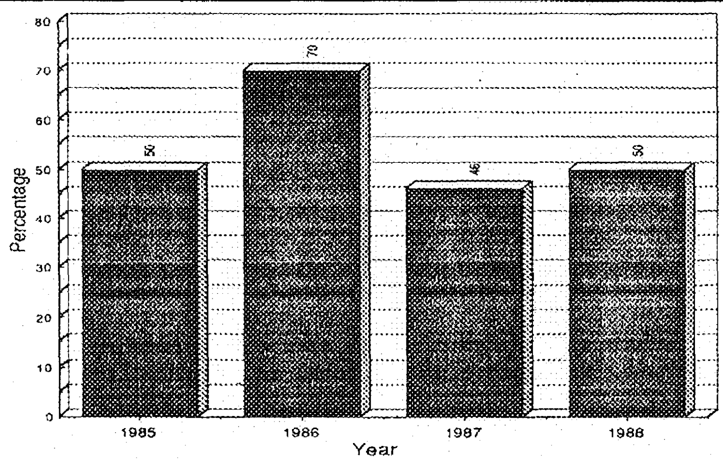
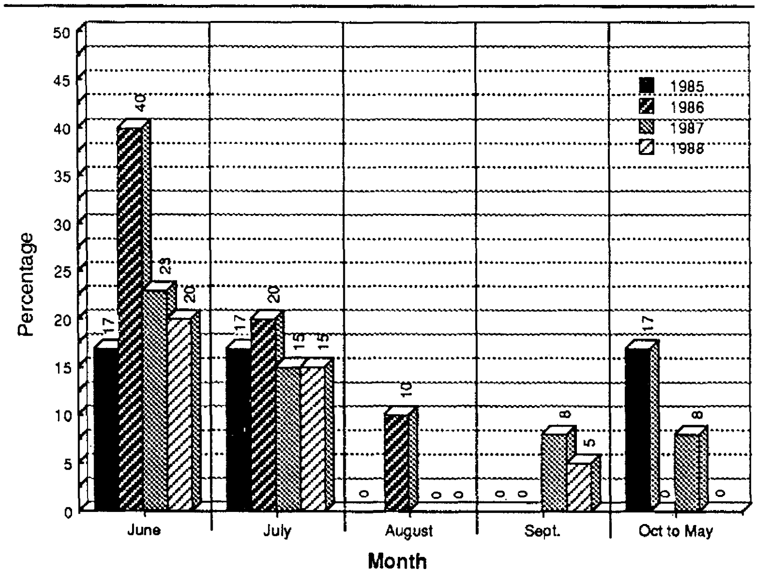


Figure 6. Percent calves lost by month, summer and winter, 1985-1988.



June, when 58% of all calf mortality occurred. Two of these calves did disappear, but they disappeared in July after they had returned to Beaver Creek. Their mother (both calves were from the same mother and disappeared in 1986 and 1988) was the earliest returnee to Beaver Creek each year, returning in mid-June. It seems that calving near Fairbanks is a highly successful reproductive strategy, apparently because of fewer predators. This evidence also attests to the importance of the Fairbanks area to WMNRA moose and vice-versa.

Natality

Figure 8 shows the number of collared cows, number of collared cows calving and number of calves born to collared cows each year of this study. The overall number of cows calving increased in 1988 due to collaring additional cows in that year. Because of the variable number of collared cows, Figure 9 shows the percentage of collared cows that calved 1985-1988. The percentage of collared cows calving (55%) in 1985 was low, indicating that 1984 may have been a poor forage production year, that conditions in winter or spring or a combination of both may have been deleterious to *in utero* survival (survival at birth), or that heavy predation occurred during calving. The percentage of collared cows calving in 1986 and

Figure 7. Number of calves born and lost in early summer (May-July) 1985-1988 in Beaver Creek (BC) and Fairbanks (FAI).

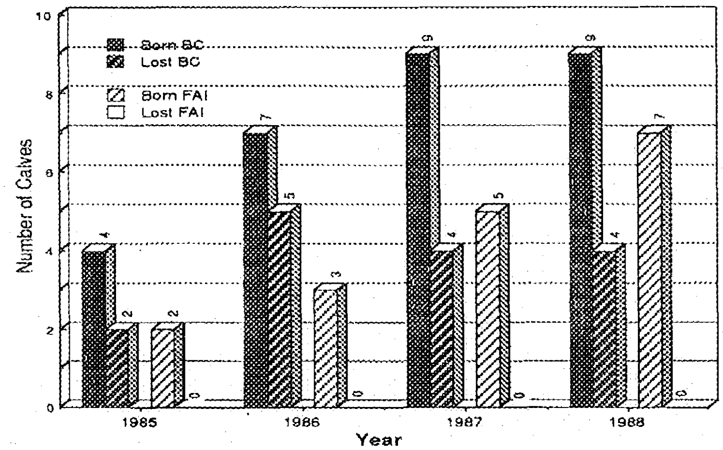


Figure 8. Number of collared cows, number collared cows calving and number of calves born by year, 1985-1988.

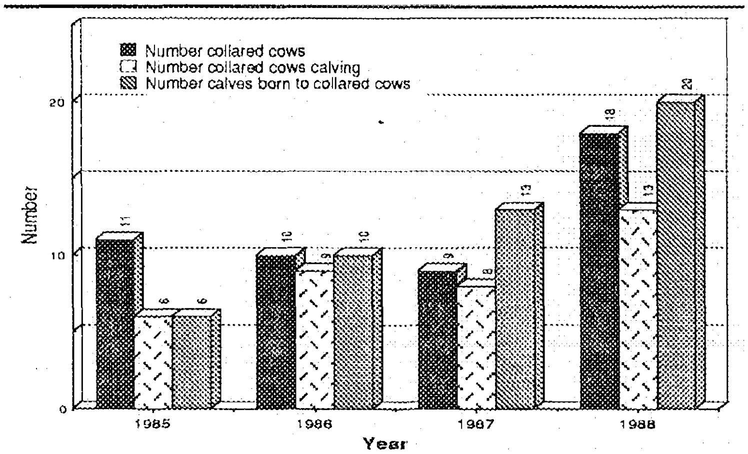
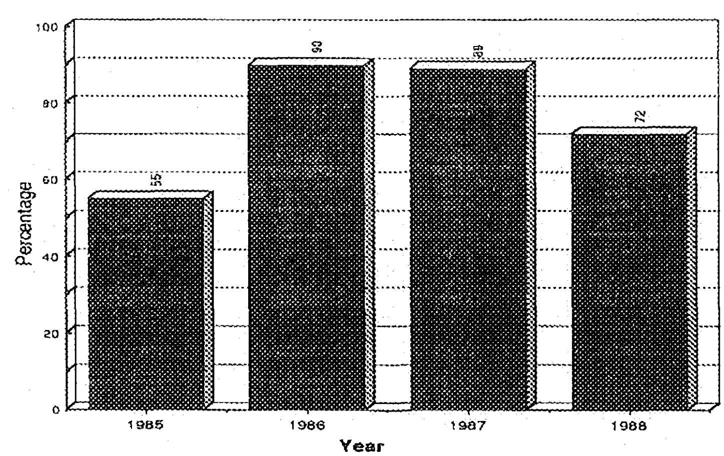
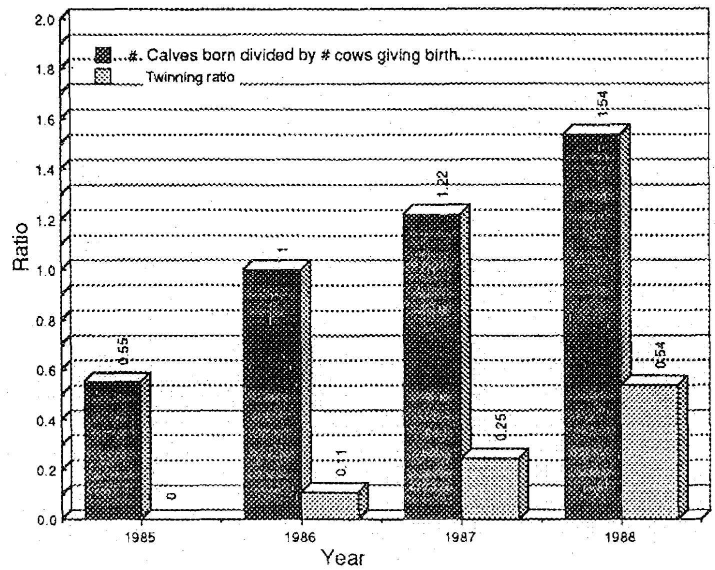


Figure 9. Percent collared cows calving by year, 1985-1988.



1987 held fairly constant near 90%. In 1988, the percentage of collared cows calving dropped to 72%.

Figure 10. Ratio of calf production by collared cows and twinning ratio (# cows bearing twins/# cows bearing calves), 1985-1988.



The number of calves born might be expected to be directly related to the percentage of collared cows calving. This was not the case and Figure 10 shows why. The number of calves born to collared, calving cows increased steadily during the years of this study. Further analysis indicates (Figure 10) that the number of twins born to collared cows caused the increase from 1985 when roughly 0.5 calves were born per collared cow to 1988 when 1.5 calves were born per collared cow. Variables responsible for this increase have been in operation at least since 1986.

Another way of looking at the effect of twins born into the population is the twinning ratio, or the number of cows bearing twins divided by the number of cows bearing calves. Figure 10 shows that collared WMNRA moose cows gave birth to no twins in 1985 but, by 1988, over half the collared cows were giving birth to twins. An increase in the twinning ratio indicates that cows entered the rut in good physical condition and maintained good health throughout the winter because of quality forage availability (Klein 1970).

Assuming that calf predation rates in the WMNRA were relatively stable during this study, as indicated in Figure 5, the extra calf present in twins represents a highly probable addition to the population, at least in the first years of an increasing moose population. Cows with twins continued to lose one calf, but the other calf generally survived. As the moose population increases, a numerical response in predators will be initiated in addition to any functional response, thereby increasing the predation.

MANAGEMENT IMPLICATIONS

It is evident that management practices in the WMNRA will have an impact on seasonal moose populations in the Fairbanks area, including numbers of animals available to hunters. Likewise, management practices in the Fairbanks area will have an impact on moose populations in the WMNRA. This includes land management, land development, hunting seasons, hunting areas and bag limits. Land development in the areas of Cripple Creek, Birch Hill and Potlatch Ponds, and in the vicinity of the Chena Lakes Recreation Area, has been encroaching on important moose calving and rearing grounds. Road and development impediments in movement corridors adversely affect the population. Increased visibility, access and disturbance associated with proposed logging in the Little Chena Valley would, for example, likely be detrimental to Fairbanks and WMNRA moose populations. Heavy hunting pressure, coupled with localized high predation rates or elimination of calving areas, could effectively eliminate this subpopulation of WMNRA moose. Since it appears that movement patterns are learned, additional time beyond a simple rebound in numbers is required to reestablish favorable movement patterns.

Low predator numbers near Fairbanks are favorable for moose calf success and general moose survival. Moose movement behavior appears to be an important aspect of moose ecology. This type of movement behavior allows the moose to utilize situations and areas that are favorable for reproduction and sustenance. It is a simple, malleable strategy that allows moose to exploit burned areas as well as locales with low predator density, such as Fairbanks, and is driven by increased survival rates and learned movement behavior by offspring.

Identification and protection of crucial moose use areas in the White Mountains will help maintain the present situation. However, proposed mineral development, recreational development, increased access and a corresponding increase in numbers of users will erode the existing status quo. Current efforts to enhance moose habitat in the WMNRA through prescription burning and wildfire management practices that emphasize resource values should allow gains to be made in enhancing populations of moose, as well as other game and furbearers. Present studies of wildfire effects on moose in the WMNRA indicate that the location of some intensive-use areas may be changed by enhancing nearby habitat. This practice has potential as a management tool to mitigate impacts (with quantifiable results) associated with development.

RECOMMENDATIONS

- Continue the "Investigation of Fire Effects on Moose Movements, Distribution, Numbers and Habitat Utilization" study.

- Monitor moose movements, habitat utilization and crucial habitat to determine effects of increasing or decreasing moose and predator populations.

- Use radiotelemetry to inventory and monitor movements, seasonal use areas, predation rates and population levels of wolves and bears.

- Monitor effects of recreation and development and formulate mitigative measures as necessary.

Data collected in this study document movements, distribution and crucial use areas of moose in upper Beaver Creek only. Data is lacking for lower Beaver Creek and the North and South units of the Steese National Conservation Area. Coordination and cooperation with the Alaska Department of Fish and Game should continue. The South Steese Unit is especially important because placer mining has altered riparian habitat and fire supression has reduced natural wildfire occurrences. The present study indicates that moose use areas, seasonal movements and predation levels can be determined in a short period of time, **if** sufficient numbers of collared animals are used.

This study has also provided sufficient information to allow selective temporal location of animals to be collared in the future, concentrating on critical periods of movement and habitat use, tailored to specific management issues. This will reduce operating costs of the collaring program.

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