SEX AND AGE DIFFERENTIAL IN SEASONAL HOME RANGE SIZE OF MOOSE IN NORTHCENTRAL ALBERTA, 1971-1979

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Abstract: Analysis of 277 home ranges of moose (Alces alces) in northcentral Alberta showed sex- and age-specific differences in seasonal home range sizes, in spite of large individual variability. Subadults (yearlings and two-year-olds) had larger home ranges than adults. The difference was found to be largely attributable to subadult males. Summer ranges of yearling males and females averaged 29.7 and 4.9 km^2, respectively. Home ranges of two-year-old males averaged 25.9 km^2 during summer and 47.9 km^2 during fall, while two-year-old females averaged 7.5 and 10.9 km^2, respectively. Of the entire male population, only two-year-olds had considerably large home ranges in the fall. Overall, moose inhabiting the Swan Hills study area had markedly larger home ranges than previously reported in other regions. The difference was related to the high degree of habitat interspersion in the boreal environments in northcentral Alberta, and to the resulting wide dispersion of food and cover resources. Winter home ranges were significantly larger than home ranges during other seasons, reflecting the limited availability of browse species.

Van Ballenberghe and Peek (1971) were first to employ radio-telemetry techniques to assess moose distribution. Since then, several studies have provided detailed information on seasonal movement patterns and home range sizes of moose in North America and Europe (Phillips et al. 1973, Addison et al. 1980, Mytton and Keith 1981, Sandergren et al. 1982). However, direct comparison between different studies and generalization of sex and age specific movements and home range sizes, are complicated by differences in habitats, techniques, and often by small sample sizes.

The Alberta Fish and Wildlife Division began a long term study in 1971 to examine moose movements and distribution in northcentral Alberta. The study extended over nine years during which a total of 131 moose were trapped and radio-collared. Preliminary results were presented by Lynch (1976).

The objective of the study was to provide site-specific baseline information on moose inhabiting northern boreal forests. This was in response to increasing recreational and industrial pressures on moose populations and habitats.

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STUDY AREA

The study area (54° 45' N, 115° W) is located on the edge of the Boreal-Cordilleran Transition (Moss 1955) and covers approximately 622 km^2 of the southeastern section of the Swan Hills. The topography is undulating with predominantly north-south running ridges interspersed with depressions and creek and river bottoms. The elevation ranges from 1,100 m in the northwest corner to 700 m in the east. Due to its elevational gradient, three different ecoregions can be identified (Strong and Leggat 1981).

Most of the study area is situated within the Boreal Foothills Ecoregion. This region lies on the west of the Boreal Mixedwood Ecoregion and presents a highly diverse vegetation. The codominance of trembling aspen (Populus tremuloides), balsam poplar (Populus balsamifera) and lodgepole pine (Pinus contorta) is diagnostic (Strong and Leggat 1981). Aspen, balsam poplar, lodgepole pine, white spruce (Picea glauca), black spruce (Picea mariana), and balsam fir (Abies balsamea) can all occur in moderately to well drained sites. These are widely interspersed among extensive muskeg plateaus and floating organic deposits, where stands of black spruce and tamarack (Larix laricina) may dominate, depending on drainage conditions.

The Boreal Mixedwood Ecoregion is found in the eastern section of the study area. Its vegetation consists largely of deciduous forest. Trembling aspen is the dominant tree species. Lodgepole pine and white

spruce are common on more xeric sites. Black spruce, willow (Salix spp.) and sedge meadows occur on poorly drained sites and in depressional areas.

The Boreal Upland Ecoregion is found in the northwest corner of the study area and is characterized by the relative absence of aspen. Lodgepole pine is dominant in well drained sites, while black spruce occurs in depressional areas.

Throughout the study area, the understory consists of green alder (Alnus crispa). Willow is found along water courses and in poorly drained sites.

The climate of the area is Boreal with Cordilleran components. The Cordilleran influence ameliorates winter temperatures (December-February mean: -10° C; Strong and Leggat 1981) and is characterized by higher winter precipitation. Maximum snow depth averages 22 cm annually (Lynch 1975).

During the study, the density of moose ranged between 0.7 and 1.6 animals per km^2. Observed sex ratios varied between 37 and 53 bulls per 100 cows, while cow-calf ratios averaged 31 calves per 100 females.

Hunting seasons were liberal, lasting three months in duration and for either sex.

During the 1970 and 1971 hunting seasons, a hunter check station was operated by the Alberta Fish and Wildlife Division along the access road into the study area. Moose were aged by the sectioned first incisor method (Sergeant and Pimlott 1959). The adult cohort (n = 125) was estimated to be comprised of 6.4 % yearlings and 57% animals older than 6 1/2 years (55% for males, 62% for females). The average age of males was 7.17 (n = 54) and of females 8.09 (n = 71).

The area supported a wolf (Canis lupus) population density of 1 animal per 83 km^2 (Fuller and Keith 1980). Black bears (Ursus americanus) and grizzly bears (Ursus arctos) were common.

METHODS

Moose were captured in the vicinity of natural mineral licks in corral type traps (LeResche and Lynch 1973). The animals were immobilized with M99 (etorphine) and instrumented with radio-transmitters mounted on collars.

A total of 1,501 locations of radio-marked animals were obtained by triangulation from two pairs of 18 m towers. Locations were recorded as compass bearings. An additional 688 radio-locations were obtained by direct sightings during periodic aerial surveys and recorded on a 1:126,720 scale map.

A computer program developed by the Department of Wildlife Ecology, University of Wisconsin and extended and modified by Morgantini (1984) was used to transform bearings into "X" and "Y" coordinates and to determine minimum perimeter polygon home range (Mohr 1947).

Animals were grouped for analysis according to three age classes: yearlings, two-year-olds and adults.

Seasonal boundaries were as follows: spring, April 1-June 10; summer, June 11-August 31; fall, September 1-November 31; winter, December 1- March 30.

Data were analyzed using ANOVA and T-Test available in the SPSS computer package (Nie et al. 1975).

RESULTS AND DISCUSSION

One hundred thirty one (131) moose (44 males and 87 females) were successfully radio-collared from 1971 to 1979. Two hundred seventy seven seasonal home ranges were constructed from a total of 2,189 radio locations.

The sizes of seasonal home ranges of males and females are summarized in Table 1.

Table 1. Size of seasonal home ranges (km^2) of moose on the Swan Hills study area (1971-1979).

		Spring	Summer	Fall	Winter
Males (n=90)	$\bar{x}$	33.2	22.1	26.1	51.6
	n	16	33	22	19
	sd	28.6	32.1	31.3	43.2
Females (n=187)	$\bar{x}$	25.6	22.7	15.4	46.8
	n	29	66	51	41
	sd	30.0	50.9	22.4	43.9

sd = standard deviation
n = number of home ranges

Both sexes were found to have significantly larger home ranges in winter than during other seasons. Winter home ranges for bulls and cows extended over 51.6 and 46.8 km^2, respectively, while the size of other seasonal ranges varied from 15.4 km^2 during fall to 33.2 km^2 in spring.

Bulls had larger average home ranges than cows during spring and fall. However, the difference between the sexes, and between spring, summer and fall, were not found to be statistically significant (Table 1).

Overall, seasonal home ranges of moose in the Swan Hills study area were larger than reported in other regions (e.g. Van Ballenberghe and Peek 1971, Phillips et al. 1973). Large home ranges may reflect a high degree of dispersion of habitats providing essential food and cover requirements (LeResche 1974). The Swan Hills area presents a complex mosaic of vegetation types, with habitat widely interspersed and of small size, typical of northern boreal environments. In this context, the results of this study are consistent with the large home ranges reported by Mytton and Keith (1981) in the Boreal Mixedwood ecoregion in northcentral Alberta (home range sizes: 1-54 km^2), and by Addison et al. (1980) in boreal forests in northwestern Ontario (home range sizes: 2-90 km^2).

Large home ranges in winter may also reflect dispersion of food resources, resulting in increased travel activity in search of widely dispersed browse species (Best et al. 1978), at a time when snow cover reduces availability of herbaceous vegetation, but seldom is deep enough to restrict moose movements.

The relationship between dispersion of resources and the size of home ranges in winter is further supported by the actual location of seasonal ranges within the study area. Even though several animals ranged over different areas in different seasons, extensive overlap between seasonal ranges were observed and have been reported by Best et al. (1978). In several instances, the difference between seasonal ranges were only limited to changes in sizes, with winter home ranges consisting of significant expansion of areas used during other seasons (Figure 1).

The average size of seasonal home ranges of individual sex and age groups is presented in Table 2. The absence of statistical significance between apparently different means may be due to the large variation of home range sizes within each sex and age group. Different weather conditions between the years did not account for this variability, since every year a wide range of home range sizes within each sex and age group was recorded. Similar individual variations have been observed by several authors (Phillips et al. 1973, Best et al. 1978, Mytton and Keith 1981). However, in spite of the inherent variability of home range sizes between individual moose, differences between sex and age groups can be detected as follows:

1. Yearling and two-year-old males had larger summer ranges than females of the same age group;

2. In the fall, the average home range size of two-year-old males (47.9 km^2) was considerably larger than that of two-year-old females (10.9 km^2) and larger than any other sex-age group;

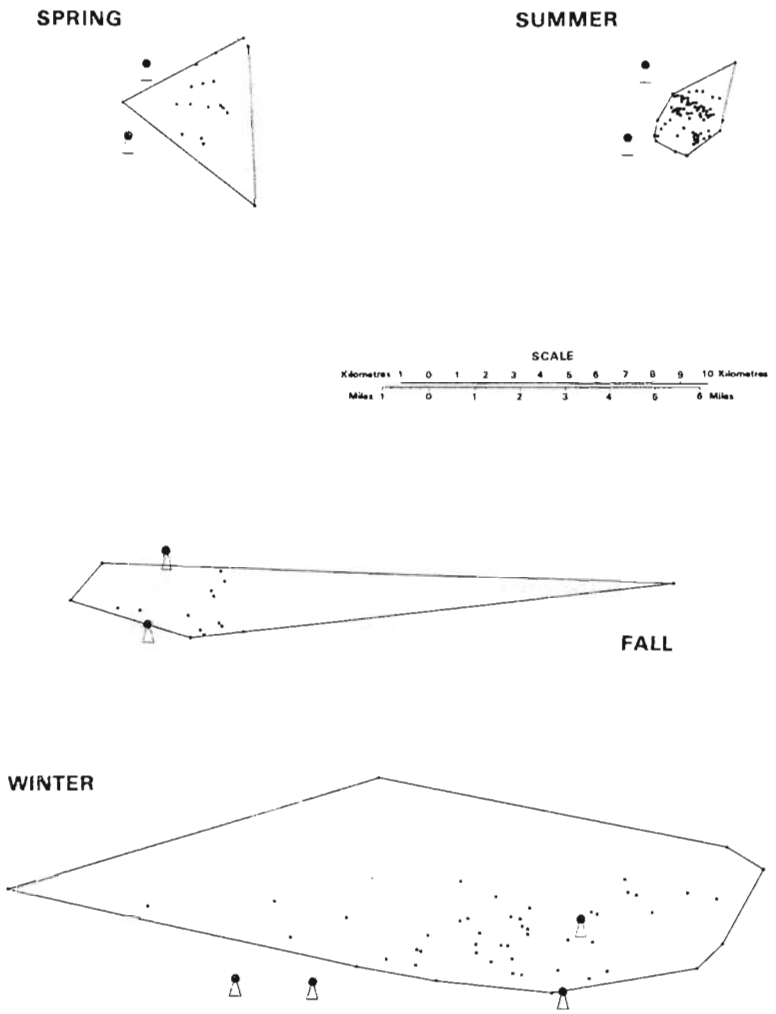

FIGURE 1. Seasonal home ranges of a yearling female moose (no. 141). In this instance the winter home range consisted of an expansion of areas used during other seasons.

Table 2. Size of seasonal home ranges (km^2) by sex and age of moose on the Swan Hills study area (1971 - 1979). Includes only animals that could be aged.

			Summer (June 11-Aug. 31)	Fall (Sept.1-Nov. 31)	Winter (Dec. 1-Mar. 31)	Spring (Apr. 1-June 10)
Yearlings (n=41)	Males (n=31)	$\bar{x}$	29.7*	17.4	58.6	19.1
		n	12	7	5	7
		sd	44.3	11.1	54.4	15.4
	Females (n=10)	$\bar{x}$	4.9*	26.3	59.6	10.7
		n	4	2	2	2
		sd	4.6	2.5	82.8	4.9
Two Year Olds (n=58)	Males (n=28)	$\bar{x}$	25.9	47.9**	62.6	52.7
		n	9	6	8	5
		sd	30.6	44.3	36.7	26.2
	Females (n=30)	$\bar{x}$	7.5	10.9**	41.9	55.8
		n	10	9	7	4
		sd	5.6	19.7	40.9	48.5
Adults (n=177)	Males (n=30)	$\bar{x}$	11.7	18.3	31.2	43.1
		n	12	9	6	3
		sd	12.7	27.7	41.4	43.0
	Females (n=147)	$\bar{x}$	27.0	15.9	47.0	21.6
		n	52	40	32	23
		sd	56.7	23.6	43.9	24.9

n = number of home ranges
sd = standard deviation
* = significantly different at $p < .05$
** = significantly different at $p < .01$

3. Adult males had smaller winter home ranges than adult females, and considerably smaller than yearlings and two-year-olds of both sexes;

4. In spring, yearlings of both sexes showed statistically significant smaller home range sizes than two-year-olds of both sexes and adult males.

Large home ranges and extensive movement patterns of subadult moose have been previously reported (Roussel et al. 1975, Lynch 1976, Addison et al. 1980, Mytton and Keith 1981) and have been interpreted as reflecting dispersion and colonization of new areas (Peek 1974, Addison et al. 1980). In this study large home ranges of subadult moose were mostly limited to the male cohort of the population. In several instances a large home range of a subadult male proved to be simply an expansion of an area that the same individual occupied when older. Long "exploratory" movements (Lynch 1976) were detected, but afterwards most of the animals returned to their original ranges. Extensive ranges and "exploratory" movements may indicate a tendency by young bulls to disperse to new ranges. This is further suggested by the significantly large home range of yearling bulls in summer, immediately after the break of the previous year cow-calf bond.

Even though instances of male moose spending the breeding season within localized areas have been described (Addison et al. 1980), increased movement patterns and large home ranges of bulls in the fall are well known (Houston 1968, Van Ballenberghe and Peek 1971, Phillips et al. 1973). Movements of animals to surrounding areas in late fall,

where they were subjected to higher hunting pressure, have been reported by Mytton and Keith (1981) in northcentral Alberta. According to Bubenik and Timmermann (1982), yearlings, after having left their mothers and unable to join other bulls, are the most mobile age class in the fall, and as such the most vulnerable to hunting. Our findings do not support this interpretation. Indeed, in the Swan Hills area in the summer, yearlings were more mobile than adults. However, in the fall, two-year-old males had considerably larger home ranges than both yearling and adult bulls, which instead ranged over relatively small areas. We interpret these results as reflecting age-specific differential in sexual maturation of bulls (Bubenik and Timmermann 1982). Two-year-old male moose at Swan Hills may have experienced an environmentally related earlier sexual maturation, than that reported by Bubenik and Timmermann (1982) in Ontario. Earlier sexual maturation would have resulted in increased search for widely dispersed breeding females. The search could have been enlarged due to the presence in the area of older, more mature dominate bulls. These results have management implications since they suggest that, in the Swan Hills region, two-year-old bulls may be more susceptible to hunting than yearlings.

Several other differences between sex and age groups, such as the small home ranges of bull and cow yearlings in spring when compared to two-year-olds, are difficult to explain without a better understanding of the ecology of moose in the study region.

The results of this study are not consistent with those of Best et al. (1978) which did not show any sex- and age-specific differences in

movements and home range sizes in a group of 47 moose inhabiting the same area where our study was conducted. It is believed that the contrasting results may be related to the high degree of variability between individual home ranges in the Swan Hills region. Because of this variability, 65 seasonal home ranges (Best et al. 1978) may not have been sufficient to detect sex and age differences.

In conclusion, it appears that moose populations inhabiting boreal environments in northcentral Alberta adapt to widely dispersed resources by ranging over large areas of land. It can be expected that during severe winters, when snow accumulation restricts long range movements, an effective reduction of forage availability may seriously affect overwinter survival and reproductive success.

The large size of winter home ranges, presumably caused by wide dispersion of forage resources, makes moose in such areas especially vulnerable to potential recreational and industrial activities, even if the activities were located far away from any one animal at any one time. The impact would consist of a reduction of otherwise available winter range limiting already scarce forage resources or causing increased energy expenditures for travel in unfamiliar areas. In this regard, a proper assessment of the impact requires a thorough investigation of food habits and quantification of abundance and distribution of food items in the area.

Finally, the variability of home ranges reported in this study further underline that the moose is a highly individualistic species.

For this reason, ecological data collected on a few individuals should be only cautiously generalized to the entire population, and even more cautiously applied to other areas. Further, even with large sample sizes, inherent variability may hamper comparisons between sex and age groups and it may keep them from reaching levels of significance aspired to by statisticians.

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