HABITAT USE BY MOOSE IN SOUTHWESTERN ALBERTA

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ABSTRACT: Moose (*Alces alces shirasi*) numbers and use of habitat were studied on the Streeter Basin Experimental Watershed in the montane aspen zone of the foothills of the Rocky Mountains in Alberta, between 1969 and 1983. Habitat use was measured by pellet counts and direct observation in relation to climatic influences. Moose winter use was heavy in shrubland and dense aspen forest and low in herbland. Upper slopes were selected while lower slopes were rejected. Exposures facing away from the sun were significantly preferred to sunny exposures. In spring, moose used cover types in proportion to their occurrence but increased their use of upper slopes. Shaded aspects were strongly preferred. Winter use of shaded exposures probably resulted from the occurrence of more browse-producing aspen forest and shrubland on those exposures. Spring observations reflect greater movement in open areas and selection of cooler shaded locations on lower, north and east-facing slopes, especially those with aspen forest.

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Moose in southwestern Alberta are considered to belong to the subspecies *shirasi* (Peterson 1955). The moose range of the west contains much open grassland and even semi-desert in contrast to the continuous boreal forest inhabited by the subspecies *A. a. andersoni* and *A. a. americana*. (Peek 1974). Some degree of seasonal altitudinal migration is apparent in most Shiras populations. Winter ranges often include several habitat types that support stable plant communities with high browse production being relatively rare (Peek 1974).

The present study was part of the Streeter Basin Experimental Watershed Project of the Alberta Watershed Research Program, a joint federal government/Province of Alberta multidisciplinary research program. The objective of the study was to determine moose habitat use in the Basin as a planning background for prediction of the impact of manipulation of vegetative cover.

STUDY AREA

The Streeter Basin Experimental Watershed is located in the Porcupine Hills of southwestern Alberta, 100 km south of Calgary at longitude 114°03'W and latitude 50°07'N (Fig. 1). Elevations vary from 1325 to 1660 m. The total area of the Basin is 5.98 km^2, and consists of two sub-basins of approximately equal area.

The climate is dry continental and falls into the "arid, with a cold season" described by Walter and Lieth (1967). In winter the foehn, or chinook, winds are accompanied by sharp rises in temperature causing melting and redistribution of snow. This phenomenon results in largely snow-free conditions over much of the area during a considerable portion of most winters. Ungulates are able to travel freely much of the time and the browse resource is available to foraging ungulates during extensive periods.

The vegetation in Streeter Basin is a transition between prairie and forest. The region has been assigned to the Douglas Fir-Aspen District of the Montane Forest Region (Jeffrey 1965, Rowe 1972) and by Strong and Leggat (1981) to their Montane Ecoregion.

The Montane Ecoregion is a transition zone between mixed prairie and the conifer-dominated Subalpine Ecoregion and contains stands characteristics of both. Three plant communities occur in Streeter Basin:

1. Herbland, mixed grass and forb vegetation (*sensu* Duvall and Blair 1962);

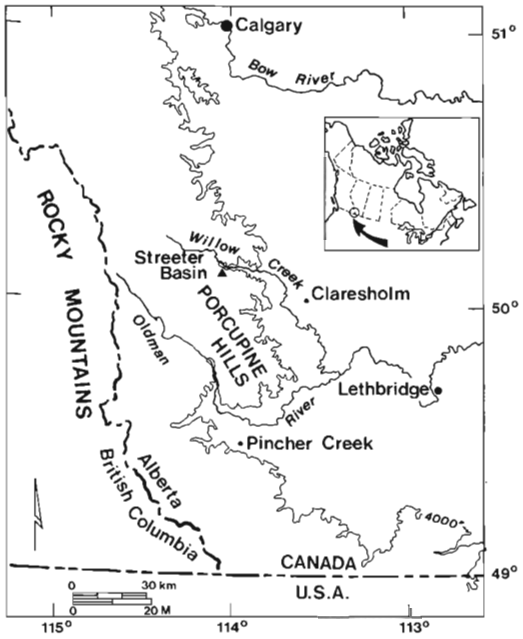

Figure 1. Key map showing the location of the Streeter Basin Experimental Watershed in Alberta.

2. Shrubland, a mixture of willows (*Salix* spp.) and water birch (*Betula occidentalis*)

3. Aspen forest, composed of trembling aspen (*Populus tremuloides*) and balsam poplar (*P. balsamifera*) with a shrub understory of saskatoon (*Amelanchier alnifolia*), rose (*Rosa acicularis*) and other species as well as tree saplings.

Moose are the principal wild ungulates in Streeter Basin and are present in all seasons. Wapiti (*Cervus elaphus nelsoni*) are present in substantial numbers during spring, summer and fall but in low numbers in winter. Mule deer (*Odocoileus hemionus*) are also common residents except in winter when they were present in variable numbers. Domestic cattle grazed the Basin during each year of the study.

METHODS

Pellet Group Surveys

A system of parallel transects was established and permanently marked on true east-west courses across the Basin 396 m (0.25 miles) apart. Permanent sample points were systematically placed at 132 m intervals with the position of the first point randomly established between 1 and 132 m of the beginning of the transect. Permanent sample points (n=112) were then established at intervals of 132 m from the first point. At each point four 10 m^2 circular plots were located at 15 m from the sample point in the cardinal directions and their centres marked with a stake and vegetation type, topographic position, aspect and slope angle recorded. The vegetation was assigned to one of the three major structural types described above. Structurally the vegetation corresponded to the aspen study area for which Collins and Urness (1981) found reasonable agreement between direct observations of habitat use and defecations by tame mule deer. The relationship between habitat use and frequency of defecations by moose is probably similar to that of other ungulates but remains to be demonstrated.

Topography was categorized as upper slope and ridge top, middle slope and lower slope, and valley bottom. Two aspects were recognized - sunny (east through south to west) and shaded (northwest through north to northeast). Plot locations were also classified into two slope steepness categories: greater or less than 20%. The proportion of plots in various landscape categories was used for comparison with the proportion of the total pellet group counts in each category to evaluate selection or avoidance by moose.

Plots were cleared of all feces in 1970 when only pellets on top of the previous year's leaf were included in the 1970 count data. Plots were searched annually in May and/or early June each year between 1970 and 1983. New feces encountered each year were removed from plots.

The 4 plots at each sampling location were grouped to make 112 sample plots of 40 m^2 for a total of 0.448 hectares. Distribution of pellet group counts among plots departed from normality. Therefore chi- square tests were conducted to determine dependance of habitat use on years. Between-year variations were further tested by the Kruskal-Wallis one-way analysis of variance. Differences in size between habitats within years were tested for significance by Kruskal-Wallis and Mann-Whitney tests. Preference or avoidance of habitat categories within years was tested by comparing proportions of pellet group counts in each to plot occurrences using Bonferroni 90% confidence intervals (Neu *et al.* 1974) calculated for the proportion of the plots that fell in each habitat category.

Direct Observations

During the first three years of the study (1970, 1971 and 1972) intensive fieldwork was conducted in Streeter Basin. Several people engaged in these activities provided an extensive coverage of the entire Basin. All moose observations were recorded.

Observations made during spring (1 April to 31 May) were believed to be unbiased in regard to vegetative type because for most of the period trees and shrubs were still leafless, visability was good in the deciduous vegetation of the Basin and all vegetation types were transected along the above-described grid of transect lines at least twice.

Meteorological Indices

Weather records for the winters of the study were obtained from the Atmospheric Environment Service's climatic station at Pekisko (Atmospheric Environment Service 1969 *et seq*). Pekisko is 28 km north of Streeter Basin at a similar elevation (1439 m) and in a topographic situation and herbland vegetation similar to the lower part of Streeter Basin. Due to the effects of chinook conditions and varied topography snow cover was a difficult parameter to evaluate. Snowfall at Pekisko was taken as an index.

RESULTS

Chi-square tests for dependency of habitat selection on year showed that distribution of moose pellet groups was independent of year among topographic positions, aspects and slope steepness categories. Only among vegetation cover types was use significantly ($p < 0.05$) dependent on year. Further evaluation with the Kruskal-Wallis one-way analysis of variance showed between-year differences to be significant in the aspen forest cover type.

Distribution of pellet groups among vegetative cover type categories (Table 1) showed that there was a strong selection for the shrubland cover type in all years while the herbland type was avoided at a significant but variable level in all years. The greatest annual difference in use was in the aspen forest. In 10 of the 14 winters use was significantly above that expected while values for the other winters did not differ significantly from availability.

The topographic subcategory of upper slopes had significant selection in 8 of 14 winters (Table 1). However, other values were close to significance rendering overall use independent of year. Middle slopes were used in proportion to their occurrence with the exception of 1980-81 when they were avoided to a significant extent. Lower slopes were significantly avoided in 10 of the 14 winters.

The shaded aspect was selected to a significant degree in all years and the sunny aspect avoided (Table 2). Slope steepness seemed irrelevant to moose as they used slopes both greater and less than 20% at expected levels in all years except 1981-82 when the less steep plots were preferred (Table 2).

Snowfall records from Pekisko (Table 3) showed that the greatest fall was 627 cm in 1979-80. Second largest snowfall was in

Table 1. Proportions of moose pellet groups in categories of vegetative cover type and topographic position compared to proportion of survey plots in those categories. Streeter Basin Experimental Watershed Alberta winters from 1969-70 to 1982-83.

Winter	Total pellet groups	Vegetative cover type			Topographic position		
		Aspen	Shrubland	Herbland	Upper slope	Middle slope	Lower slope
1969-70	46	0.652+	0.283+	0.065-	0.478+	0.304	0.217
1970-71	74	0.554+	0.351+	0.095-	0.365	0.446	0.189
1971-72	95	0.611+	0.284+	0.105-	0.484+	0.368	0.147-
1972-73	70	0.343	0.600+	0.057-	0.586+	0.300	0.114-
1973-74	74	0.460	0.500+	0.041-	0.419	0.460	0.122-
1974-75	73	0.548+	0.425+	0.027-	0.384	0.452	0.164-
1975-76	89	0.405	0.517+	0.079-	0.438	0.416	0.146-
1976-77	78	0.487	0.436+	0.077-	0.500+	0.423	0.077-
1977-78	65	0.569+	0.354+	0.077-	0.539+	0.339	0.123-
1978-79	100	0.630+	0.320+	0.050-	0.480+	0.360	0.160-
1979-80	65	0.508	0.339+	0.154-	0.539+	0.323	0.139-
1980-81	88	0.546+	0.409+	0.046-	0.580+	0.239-	0.182
1981-82	59	0.644+	0.339+	0.017-	0.356	0.356	0.288
1982-83	90	0.522+	0.422+	0.056-	0.433	0.422	0.144-
Mean	76.1	0.532+	0.401+	0.068-	0.471+	0.374	0.155-
Proportion of plots		0.420	0.179	0.402	0.348	0.393	0.259
Upper confidence limit		0.519	0.256	0.500	0.444	0.491	0.347
Lower confidence limit		0.304	0.102	0.303	0.253	0.295	0.171

+,- Values above or below the Bonferroni 90% confidence intervals on the proportion of plots.

Table 2. Proportion of moose pellet groups in categories of aspect and slope steepness compared to proportion of survey plots in those categories. Streeter Basin Experimental Watershed, Alberta, winters from 1969-70 to 1982-83.

Winter	Total pellet groups	Aspect		Slope steepness	
		Sunny[1]	Shaded	<20%	>20%
1969-70	46	0.152-	0.848+	0.478	0.522
1970-71	74	0.392-	0.608+	0.500	0.500
1971-72	95	0.347-	0.653+	0.495	0.505
1972-73	70	0.286-	0.714+	0.557	0.443
1973-74	74	0.284-	0.716+	0.514	0.487
1974-75	73	0.425-	0.575+	0.466	0.534
1975-76	89	0.281-	0.719+	0.562	0.438
1976-77	78	0.321-	0.680+	0.449	0.551
1977-78	65	0.292-	0.708+	0.539	0.462
1978-79	100	0.230-	0.770+	0.530	0.470
1979-80	65	0.3622-	0.631+	0.385	0.615
1980-81	88	0.352-	0.648+	0.546	0.455
1981-82	59	0.288-	0.712+	0.661+	0.339-
1982-83	90	0.356-	0.644+	0.511	0.489
Mean	76.1	0.316-	0.684+	0.514	0.486
Proportion of plots		0.545	0.455+	0.518	0.482
Upper confidence limit		0.637	0.548	0.610	0.575
Lower conidence limit		0.452	0.363	0.425	0.390

+,- Values above or below the Bonferroni 90% confidence intervals on the proportion of plots.
[1]"Sunny" aspects were east through southwest. "Shaded" were northwest, north and northeast.

Table 3. Total snowfall, Pekisko climatological station, Alberta.

Year	Snowfall (cm)
1969-70	361
1970-71	308
1971-72	431
1972-73	292
1973-74	235
1974-75	306
1975-76	234
1976-77	321
1977-78	231
1978-79	350
1979-80	627
1980-81	167
1981-82	254
1982-83	232
Mean	294

Table 4. Moose observations during spring (April 1 - May 31) in habitat categories. Streeter Basin Experimental Watershed, Alberta,1970-72.

	% of area	No. of moose observations	(%)
Vegetation Type			
Herbland	40	15	(40)
Shrubland	18	6	(16)
Aspen forest	42	17	(44)
Chi-square = 0.1683			
Topographic Position			
Lower slope & flat	26	10	(30)
Middle slope	39	9	(26)
Upper slope & ridge	35	15	(44)
Chi-square = 2.307			
Aspect[1]			
Shaded aspect	45	28	(78)
Sunny aspect	55	8	(22)
Chi-square = 15.627*			

1971-72. Least snowfall was 167 cm in 1980-81.

Observations of moose during spring in vegetation type subcategories (Table 4) were in proportion to occurrence of these types as were observations listed by topographic position. However, the data indicate that the winter preference for shaded aspects continued into the spring.

Proportions of moose pellet groups occurring in the herbland cover type were correlated with total snowfall at Pekisko ($r=0.77$, $df=12$, $p<0.01$). Probably moose spend more time in herbland in snowy winters because snow blows off of those areas and piles up in shrub and aspen stands.

The high use of the shaded aspect was at least partially due to the occurrence of the selected shrubland and the frequently-selected aspen forest cover types on shaded aspects. A chi-square test of plot frequencies in the categories of vegetation type and aspect showed that those parameters were significantly dependent (chi-square $p < 0.001$). Tests of other combinations of the four parameters failed to demonstrate significant dependence.

Previous studies have shown that moose significantly selected land survey blocks with a large production of woody browse (Telfer 1978 and 1984). Greatest browse production per hectare was in the shrubland type with the aspen forest type a close second (Telfer 1978 and in prep.), probably contributing to the high level of use found in those types during the 14 years of the present study. Percentage of plots on shaded aspects that also fell in shrubland or aspen was 78% compared to 49% of the plots on sunny aspects. This difference in browse availability probably explains moose selection of the areas of shaded aspect. Similarly, in the preferred upper slope category of topographic position, 67% of the plots were in either aspen or shrubland compared to 45% of those on the lower slopes avoided by moose.

Table 5. Moose pellet group densities per hectare for certain land classes in Alberta.

Land class	Streeter Basin[1]	Elk Island National Park[2]	Medicine Lake[3]
Vegetative cover types			
Aspen Forest	215	98	29.2[4]
Shrubland	380	225	90.6[5]
Herb or grassland	29	19	1.7[6]

[1]From the present study (area subject to hunting).
[2]From Cairns 1976 (area fenced and subject to occasional moose culling to control numbers).
[3]From Westworth *et al.* 1984 (area subject to hunting).
[4]Mean of values for 60 and 80 year old stands for 1980-81 and 1981-82.
[5]Mean of values for a sapling aspen stand 14 years old in 1981.
[6]Value for a regenerating aspen stand one year after logging.

DISCUSSION

The study confirmed the importance of browse availability in the winter distribution of moose reported by earlier studies (Telfer 1978, Pierce and Peek 1984). The selection of the shrubland type was particularly marked as it was in two other Alberta areas (Table 5) and in Idaho (Jenkins and Wright 1988). Based on pellet groups per hectare the level of moose use on all stands in Streeter Basin was higher than in comparable stands in the two other areas, testifying to the value of the montane ecoregion as moose range.

Snowfall also played a role in moose distribution as large snowfalls were significantly related to use of herbland where moose were probably seeking patches where snow had blown off. In all years, however, moose utilized herbland less than expected based on its availability. Jenkins and Wright (1988) reported similar avoidance of herbland. Moose also significantly preferred shaded aspects in all years. In addition to the fact that aspen and shrubland types were more extensive on shaded aspects, there may have been an avoidance of thermal stress because even in winter daytime temperatures were often greater than the -5°C upper limit of the moose thermoneutral temperature range determined by Renecker (1987). It is noteworthy that spring observations of moose were also significantly higher on the shaded aspect.

The present study demonstrates that, for moose, maintenance of shrubland stands in a productive state interspersed with aspen forest is highly important in southwestern Alberta. This finding has been incorporated into moose range improvement projects in the region by the Alberta Fish and Wildlife Division and into experimental vegetation management in Streeter Basin.

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