Food Habits of Moose, *Alces alces*, in Alaska: A Preliminary Study Using Rumen Contents Analysis

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Abstract. One hundred and sixty-six samples of moose (*Alces alces*) rumen contents from the Fairbanks and Kenai areas of Alaska were analyzed to quantify regional and seasonal moose habitat interactions in Alaska. We are 95% confident that the frequency of major food items from 44 to 51 samples collected during winter near Fairbanks and Kenai, Alaska, have been established within ± 15% deviation.

Six studies of moose (*Alces alces*) food habits have been reported from Alaska (Peek 1973). In the Susitna Valley in south-central Alaska, Chatelain (1951) found, through analysis of moose rumen samples, that mat willow (*Salix* spp.), birch (*Betula papyrifera* var. *kenaica*), cottonwood (*Populus trichocarpa*), and aspen (*Populus tremuloides*) constituted practically all the winter food of moose in this area. Alder (*Alnus fruticosa*), rose (*Rosa acicularis*), highbush cranberry (*Viburnum edule*), or other plants were rarely consumed; and spruce (*Picea* spp.) was not eaten.

Spencer and Chatelain (1953) found that plant succession on areas burned by wildfire in south-central Alaska followed a variety of patterns, resulting in creation of useful moose winter range from 0 to 50 years. Under average conditions, stands appeared to furnish good forage for 15 to 20 years after the fire. Spencer and Chatelaine (1953) felt that the 290 000-acre fire in 1947 on the Kenai Peninsula induced an increase in moose populations of approximately 400% between 1950 and 1953. In the 3 years following this fire, significant forage was produced, 96% of which was aspen sucker growth. Some of this conclusion was based on analysis of 96 samples of moose rumen contents. Details of this analysis were not reported.

Leopold and Darling (1953a, b), Chatelain (1952), Spencer and Hakala (1964), and Hakala et al. (1971) wrote about the effect of fire on moose-habitat interactions in the Copper River, Susitna, and Kenai areas of Alaska. They agreed that fire improved moose habitat through increased productivity and availability of deciduous woody plants (willow, aspen, birch, alder, and cottonwood) and that moose populations in these areas increased in response to improved habitat conditions.

The previous observations are primarily qualitative and do not permit comparative analysis. This effort initiated a study to quantify moose food habits in Alaska as determined by rumen content analysis.

The moose rumen samples were collected from the Fairbanks and Kenai Peninsula areas of Alaska. Winter (November to March) habitats of moose near Fairbanks consist primarily of shrub and deciduous tree communities. Vegetation in shrub habitats ranges from pure to mixed stands of willows (*Salix* spp.) and alders (*Alnus incana, A. crispa*), frequently with a dense understory of herbs and low shrubs (*Rosa acicularis, Potentialla fruticosa, Ledum palustre, Vaccinium uliginosum, Viburnum edule*). Deciduous tree communities consist of paper birch, quaking aspen, and balsam poplar (*Populus balsamifera*). Understory vegetation ranges from a dense herbaceous cover in balsam poplar stands to mixed herbs and low shrubs in aspen and birch stands. Pure or mixed stands of coniferous trees (*Picea glauca, P. mariana, Larix laricina*) occurring throughout areas are used by moose during both winter and summer.

Winter habitats of moose on the Kenai Peninsula consist primarily of shrub and deciduous tree communities. Shrub communities are composed of

willows and alders (*Alnus tenuifolia, A. sinuata*); deciduous tree habitats consist of paper birch and quaking aspen. Understory vegetation is dominated in many areas by mountain-cranberry (*Vaccinium vitis-idaea*).

Winter weather conditions contrast sharply between interior Alaska and the Kenai Peninsula (Johnson and Hartman 1969). In interior Alaska, snow-cover thicknesses of 70 cm or more persisting for 4 to 6 months in winter moose habitat are the rule, and thicknesses in excess of 90 cm are not unusual. Winter thawing is rare, and snow cover tends to persist until spring. On the Kenai Peninsula, however, snow-cover thicknesses in winter moose habitat range near 40 cm for short periods and seldom reach 60 cm. Winter thaws are common, and bare ground may be exposed at any time throughout the winter. Snow conditions in interior Alaska differed somewhat between the winters of 1970–72. During the winter of 1970–71, the National Weather Service in Fairbanks documented a record snowfall of 307 cm (average total snowfall is 177 cm). Snow-cover thicknesses in excess of 90 cm persisted from December through March. During the winter of 1971–72, total snowfall in Fairbanks was 230 cm, and snow-cover thicknesses ranged between 60 and 73 cm from December through March. Snow-cover thicknesses on winter moose range around Fairbanks were somewhat greater during both winters than indicated by National Weather Service records.

Fall (September and October) and spring (April and May) represent periods of transition between winter and summer habitats. Rumen samples obtained during spring and fall, however, were collected primarily from moose on winter range. During summer (June–August), habitats of moose consist primarily of herbaceous and heath bogs.

Methods

In this preliminary study approximately three-fourths of the 166 rumen samples examined were collected and frozen prior to this exploratory study. The quantity of material collected from individual moose varied from one to several litres. In our study, 1 litre of rumen content was analyzed. This was done without knowing whether the 1 litre was representative of materials in a moose rumen.

The 1-litre sample was emptied into a gang of sieves and washed for several minutes with fresh water. Material retained in a 6.35-mm mesh sieve was separated to species when possible and sorted into plant parts such as fruits, green leaves, dry leaves, succulent twigs and buds, or roots. Unidentified items were categorized into 26 groups. The volume of each plant part was determined by water displacement and the importance calculated by adding the frequency of occurrence of a plant part to volume and dividing the sum by 2.

$$\text{Importance index} = \frac{\text{volume} + \text{frequency.}}{2}$$

Results*

Winter (November–March)

During the winter of 1970–71, examination of 44 samples of moose rumen contents from the Fairbanks area revealed a diet of primarily deciduous woody plants (Table 1). Of the identified food items, twigs of willow, birch, aspen, and alder, in decreasing order, were most frequently eaten. Other foods, by decreasing frequency, included fruit, dry aspen leaves, spruce twigs, willow fruit, and dry leaves. A small quantity of unidentified herbaceous material was found in one sample.

During the winter of 1971–72, 10 samples of moose rumen contents from the Fairbanks area were analyzed. As was the case during the previous winter, the diet consisted primarily of deciduous woody materials. The different snow conditions between the winters of 1970–71 and 1971–72 in interior Alaska did not influence the frequency of major food items found in rumen contents of moose. Also, during periods of greater than normal snow cover when moose died from starvation (winter of 1970–71), only one of the 44 samples contained spruce. It therefore appears that spruce is not consumed by moose near Fairbanks, even during periods of thick snow cover when the availability of deciduous browse is severely restricted.

A total of 51 samples collected from the Kenai Peninsula during the winter of 1971–72 was analyzed. Twigs of birch, aspen, and willow, in decreasing order, were most frequently eaten. The other most frequently eaten foods, in decreasing

*Details of analysis available from Forest Service, USDA, Forest Environment Research, Washington, D.C. 20250.

TABLE 1 —Seasonal occurrence of plants in a 1-litre sample of moose rumen contents from the Fairbanks and Kenai regions, Alaska. Data are expressed as percentages of animals

Plants	Winter			Spring			Summer and Fall		
	Fairbanks		Kenai	Fairbanks		Kenai	Fairbanks		
	1970–71 *n*=44	1971–72 *n*=10	1971–72 *n*=51	1971 *n*=15	1972 *n*=6	1972 *n*=8	Summer 1972 *n*=10	Fall 1971 *n*=7	Fall 1972 *n*=15
Woody									
Identified									
Trees									
1. Aspen									
Twigs									
Hardened	56.8	20.0	76.5	20.0	16.7	75.0	0	28.6	6.7
Succulent	0	0	0	6.7	0	0	0	0	0
Leaves									
Dry	2.3	0	0	0	0	12.5	0	0	0
Green	0	0	0	0	0	0	10.0	0	13.3
2. Birch									
Twigs									
Hardened	70.5	90.0	78.4	80.0	100.0	62.5	40.0	71.4	66.7
Succulent	0	0	0	0	0	0	10.0	0	0
Leaves									
Dry	0	0	13.7	0	0	50.0	0	14.3	20.0
Green	0	0	0	0	0	0	0	28.6	6.7
Fruit	0	70.0	3.9	0	50.0	0	0	42.9	0
3. Cottonwood									
Twigs									
Hardened	0	20.0	17.0	0	16.7	0	0	0	20.0
Succulent	0	0	2.0	0	0	12.5	0	0	0
Leaves									
Green	0	0	0	0	0	0	0	0	6.7
4. Spruce									
Twigs									
Hardened	2.3	0	0	6.7	0	12.5	0	0	0
Needles									
Dry	0	0	0	0	0	12.5	0	0	6.7
Green	0	10.0	2.0	0	0	0	0	0	0
5. Larch									
Twigs									
Hardened	0	0	2.0	0	0	0	0	0	6.7
Tall shrubs									
1. Willow (unknown)									
Twigs									
Hardened	86.4	100.0	52.9	86.7	100.0	62.5	0	85.7	86.7
Succulent	0	0	0	13.3	0	0	90.0	0	0
Leaves									
Dry	2.3	10.0	0	26.7	0	0	0	42.9	40.0
Green	0	0	2.0	20.0	0	0	100.0	42.9	6.7
Fruit	2.3	10.0	0	26.7	0	0	0	0	0
2. Shrub birch									
Twigs									
Hardened	0	0	0	6.7	0	0	0	14.3	0
Succulent	0	0	0	0	0	0	10.0	0	0
Leaves									
Dry	0	0	0	0	0	0	10.0	14.3	13.3
Green	0	0	0	0	0	0	60.0	0	0

TABLE 1 – *continued*

Plants	Winter			Spring			Summer and Fall		
	Fairbanks		Kenai	Fairbanks		Kenai	Fairbanks		
	1970–71 *n*=44	1971–72 *n*=10	1971–72 *n*=51	1971 *n*=15	1972 *n*=6	1972 *n*=8	Summer 1972 *n*=10	Fall 1971 *n*=7	Fall 1972 *n*=15
3. Alder									
Twigs									
Hardened	25.0	30.0	3.9	13.3	50.0	0	0	28.6	20.0
Succulent	0	0	0	0	0	0	10.0	0	0
Leaves									
Dry	0	0	0	0	16.7	0	10.0	0	6.7
Green	0	0	0	0	0	0	10.0	0	6.7
Fruit	4.6	20.0	9.8	6.7	16.7	0	0	0	6.7
Low shrubs									
1. *Vaccinium* sp.									
Twigs									
Hardened	0	0	0	13.3	0	0	0	0	0
Leaves									
Green	0	0	29.4*	6.7	0	62.5*	0	14.3	6.7
2. *Ledum*									
Leaves									
Green	0	0	3.9	0	0	0	0	0	6.7
3. *Arctostaphylos*									
Leaves									
Dry	0	0	2.0	0	0	0	0	0	6.7
Green	0	0	2.0	0	0	0	0	0	0
4. *Rosa*	0	0	2.0	0	0	0	0	0	0
Unidentified									
Twigs									
Hardened	93.2	100.0	96.1	100.0	100.0	87.5	0	100.0	86.7
Dead + Bark	34.1	10.0	31.4	33.3	0	37.5	0	0	0
Leaves									
Dry	31.8	40.0	21.6	13.3	0	0	0	14.3	20.0
Green	2.3	5.0	0	0	16.7	0	0	28.6	53.3
Herbaceous									
Identified									
Lichens	0	0	3.9	0	0	0	0	0	0
Selaginella	0	0	2.0	0	0	0	0	0	0
Equisetum	0	0	5.9	0	0	12.5	90.0	28.6	20.0
Unidentified									
Fruit	0	0	0	0	0	0	0	14.3	0
Grass	0	0	17.7	6.7	0	12.5	50.0	14.3	6.7
Mushrooms	0	0	0	6.7	0	0	0	0	13.3
Sedges	0	10.0	0	13.3	0	0	0	14.3	0
Dry stems	2.3	0	0	0	0	0	0	14.3	0
Green stems, leaves	0	0	3.9	0	0	0	0	0	0

* *Vaccinium vitis-idaea.*

order, were green leaves of mountain-cranberry, grass, cottonwood twigs, dry birch leaves, alder fruit, *Equisetum*, lichens, green *Ledum* leaves, alder twigs, and birch fruit. The remaining identified food items occurred in only one of the 51 samples. The increase in use of herbaceous and ericaceous plants on the Kenai Peninsula versus the Fairbanks area is attributed primarily to the greater availability during winter of low-growing plants on the Kenai, due to mild snow conditions (LeResche and Davis 1973). Moose at Fairbanks most frequently ate willow, birch, and aspen, in decreasing order; but at Kenai, they most frequently ate birch, aspen, and willow. This dif-

ference is attributed primarily to food availability, not to differences in preference. LeResche and Davis (1973) observed the winter feeding habits of three semi-tame moose at the Kenai Moose Research Center. They found that between February and May, birch twigs, mountain-cranberry, willow, alder, and white spruce comprised 72, 21, 3, 3, and 1% of the diet, respectively. Our examination of 51 samples of rumen contents of animals from this same general area during winter revealed birch, aspen, willow twigs, green mountain-cranberry leaves, cottonwood twigs, and grass as the more frequently eaten foods.

Spring (April–May)

During the spring of 1971, analysis of 15 samples from Fairbanks revealed that hardened twigs of willow and birch were most frequently eaten. Other foods, in descending order of importance, were fruit and dry leaves of willow, hardened aspen twigs, green willow leaves, hardened alder twigs, sedges, hardened *Vaccinium* twigs, and succulent willow twigs.

During the spring of 1972, six samples collected near Fairbanks showed hardened willow and birch twigs in all samples, birch fruit and hardened alder twigs in half the samples. Analysis of eight samples collected from Kenai during spring of 1972 revealed hardened aspen twigs, followed by hardened willow and birch twigs, green leaves of mountain-cranberry, and dry birch leaves to be the most frequently eaten items.

Summer (June–August)

During the summer of 1972, 10 samples were collected near Fairbanks. All samples contained green willow leaves. Succulent willow twigs and *Equisetum* were found in nine samples. Six samples contained green shrub birch leaves, five had grass, and four had hardened birch twigs.

Fall (September–October)

During the fall of 1971, seven samples were collected near Fairbanks. Hardened twigs of willow and birch were followed in descending order by birch fruit, dry and green willow leaves, hardened aspen twigs, green birch leaves, hardened alder twigs, and *Equisetum*.

During the fall of 1972, 15 samples from the Fairbanks area contained hardened willow and birch twigs, dry willow and birch leaves, hardened twigs of cottonwood and alder, and *Equisetum*.

Conclusions and Recommendations

Results in this report are indicative of seasonal and regional variations in moose-habitat interactions. The small sample size within season and location precludes statistical analysis. Based on the formula developed by Hanson and Graybill (1956) we are, however, 95% confident that the frequency of major food items from 44 to 51 samples collected during winter near Fairbanks and Kenai has been established within ± 15% deviation.

These preliminary data, although more detailed, are in basic agreement with what Chatelain (1952) reported after analyzing moose rumen contents from Susitna to determine winter food habits. Locational and seasonal differences in moose food habits are evident from these data; however, to obtain food frequency information with a deviation of ± 10%, approximately 100 rumen samples should be examined for each season within specific geographic regions. This sample size is based on calculations from the formula of Hanson and Graybill (1956) and variations in the frequency of major food items in moose rumen samples from Fairbanks and Kenai, Alaska.

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