COMPARATIVE ANALYSIS OF MOOSE NUTRITION OF THE ANADYRSKY AND OMOLONSKY POPULATIONS (FAR NORTH EAST) IN DIFFERENT SEASONS

N.K. Zheleznov-Chukotsky and E.S. Votiashova

North East Chukotka Nature Department, Pacific Geography Institute, Russian Sciences Academy, Chukotka, Anadyr, P.O. Box 16, 686710, Russia

ABSTRACT: Food habits of moose (*Alces alces*) were studied for 6 years in northeastern Russia in the Anadyrsky and Omolonsky populations. Moose ate twigs, bark, leaves, and needles of trees and shrubs, and herbs and mushrooms. In May and June moose in the Anadyrsky population ate twigs of 16 species of trees and shrubs, and 8 species of herbs, mainly Gramineae. Moose in the Omolonsky region ate 9 species of shrubs and trees, mainly *Salix*, and 9 species of herbs again mostly Gramineae. Herbs dominated the July-August diet of both populations. At Anadyrsky 40 species were taken and at Omolonsky 30 species were taken, mainly aquatic and marsh plants. In autumn and winter in both areas, moose switch to twigs, tree bark, and mushrooms. Food habits of moose in this region resembled North American diets, especially use of aquatic and marsh plants. Calculations of available forage indicate that 6,000-6,500 moose could exist in Chukotka.

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We review investigations of moose food habits in northeastern Russia. These areas include the Chukotka region in the far northeast, the upper Kolyma and Okhotsky regions, and Yakutia. Comparisons with diets in other regions are made where appropriate. Particular reference is to the Anadyrsky and Omolonsky basins in Chukotka.

METHODS

Moose inhabiting the Anadyrsky and Omolonsky basins in Chukotka may be conditionally considered 2 different populations. Food habits were studied from analysis of 12 rumens collected in the areas, and from herbarium collections of plants that were eaten. Rumen and gullet contents were collected from moose that were shot just after feeding, passed through a sieve, and fixed in 8% formalin. During the winters of 1973-1977 and 1989-1991, moose were observed feeding day and night, using methods modified after Nasimovich (1948) and Timofeeva (1967). Species of trees, shrubs, and herbs were recorded at 47 winter feeding sites. Twigs were collected, stored at room temperature, and allowed to grow leaves, which were then identified to species based on leaf configuration.

Carotine, protein, calcium, and phosphorus content of rarely consumed and highly selected plants were examined.

RESULTS

Nutrition In Spring

Moose of both populations used 101 plant species, including 32 woody species, 66 herbs, and 3 mushrooms. Food habits changed monthly depending upon availability, particularly during winter. In spring (May-June), food habits of the Anadyrsky basin moose included 16 species of woody plants, occurring in 72.1% of observations, leaves and needles of woody plants (31.8%.

occurrence), bark (18.2% occurrence, primarily *Populus suaveolens, Chosenia arbutifolia*, and *Sorbia* spp.). Herbs occurred in 17.8% of observations, generally Gramineae and Cyperaceae. In the Omolonsky basin in spring, moose fed on trees, including *P. suaveolens* and *Ribes* spp., occurring in 68.2% of observations. Twigs of 8 species of *Salix* were observed to be taken (Table 1). Nine species of herbs were taken in both river basins in spring.

Nutrition In Summer

In summer (July-August), plants were at the height of flowering and budding phases, and 40 species of herbs occurred in 88.9% of the observed diet of the Anadyrsky population. The leaves and twigs of arboreal plants have high protein and fat content (8.4 and 1.5% respectively). Protein and fat content of shoots and leaves of *Betula exilis* was 5.9 and 3.9%, respectively, and for *Vaccinium uliginosum*, 4.8 and 1.5%, respectively. *Eriophorum vaqinatum* contained 7.0 and 1.2%, and *Carex saxatilis* had 6.9 and 1.1% protein and fat, respectively.

In early July, twigs declined in the observed diet to 59.1% occurrence in samples, and tall shrubs declined to 29.9%. Moose preferred shoots of *Populus suaveolens, Chosenia arbutifolia , Ribes dikuscha* and *Salix* spp. Young shoots of *Chosenia* and other willows with diameters to 3 mm were most common in rumens in July and August. Bark was absent in the observed diet, but fruits, seeds and twigs were present in 20% of samples. Moose browsed on *Ribes* spp. branches containing berries and took less *Vaccinium* spp. and *Rhodococcum* spp.

From July into September, moose used riverine habitats where bloodsucking insects were absent. Feeding sites included forest edges, pebble spits and islands, outlets of large channels, and shallow rivers where winds often were >12 m/sec. (Zheleznov 1975). Moose also used tundra and forest lakes and marshes up to 100 ha in size which contained abundant sedges, aquatic plants, and shrubs along the edges.

Typically, aggregations of 6 to 8 moose may be observed at these aquatic sites. In western Chukotka, >12 individuals may be commonly seen. Moose feed on Potamogetonaceae, which the animals take from the bottom of a pool by plunging into the water with their heads. *Equisetum*

Table 1. Forage groups in the moose diet in the Anadyrsky and Omolonsky basins of northeastern Russia, expressed as number of species and (percentage).

Forage Group	Area	May-June	July-Aug.	Sept-Oct.	Nov.-April
Twigs of trees, shrubs, undershrubs	Anadyrsky	16(72.7)	13(59.1)	18(81.8)	16(72.7)
	Omolonsky	15(68.2)	16(72.7)	18(81.8)	13(50.9)
Leaves, needles of trees and shrubs	Anadyrsky	4(31.8)	13(59.1)	12(54.6)	5(22.7)
	Omolonsky	15(68.2)	18(81.8)	5(22.7)	1 (4.5)
Herbs and undershrubs	Anadyrsky	8(17.8)	40(88.9)	44(97.7)	16(35.6)
	Omolonsky	9(26.5)	30(85.7)	16(47.1)	3(8.8)
Tree bark	Anadyrsky	4(18.2)	- -	- -	2(9.1)
	Omolonsky	1(4.5)	- -	1(4.5)	3(13.6)

palustre, E. fluviatile, Hippuris vulgaris, Menyathes trifoliata were observed to be taken by adults, primarily bulls, by swimming into a lake and diving to reach these species. Foraging in lakes, primarily by adult males, continued into September as long as ice does not prevent it. Along the outlying edges of lakes and marshes moose also use *Salix* spp., *Vaccinnium* spp., and *Betula* spp.

Similar aquatic feeding patterns were observed in the Amursko-Ussuriisky krai by Cherkasov (1962) and Rakov (1965), in Yakutia by Labutin (1976), and in the Altai by Sobansky (1980,1981,1988). Analogous behavior was observed in British Columbia by Ritcey and Verbeek (1969) and in Quebec by Joyal and Scherrer (1978). In Alaska, sedges and aquatic plants made up 10% in the moose diet (Peek 1974).

Moose may be divided into 4 groups according to their behavior at the lakes. The first group includes moose feeding on emergents taken from edges by animals which do not swim. Moose taking food from the offshore part of a lake constitute a second group. When feeding, they walk on the bottom of the lake. The third group consists of moose, which swim without diving, and take plants rising to the surface. Moose of the fourth group dive and may remain below the water surface as long as 10-15 seconds to graze bottom plants. Domnich (1983) reported the total quantity of water plants eaten by 3 moose was 9.5, 8, and 18 kg in rumens. Daily intake estimates were up to 28-30 kg of aquatics.

We observed moose remaining under water for as long as 1 min, and they may remain in lakes and marshes up to 4-6 h (Zheleznov 1976,1990,1994). Domnich (1983) reported moose staying in lakes up to 6 h in the Omolonsky basin.

Spring - summer moose food habits in other regions of northeastern Russia are more variable where plant communities are more diverse. Woody plants appear to constitute a higher proportion of the diet in the far northeast (Table 2) than in other areas, where herbs constitute more of the diet.

However, moose do not use a large number of species during spring and summer. In the upper Kolyma and Okhotsky regions, only 19 species were observed to be consumed, mainly *Salix udensis, S. boganidensis,S. daurica, S. pulchra, S. reticulata, and S. chamissonis*. In Yakutia and the Khabarovsky region, moose generally used twigs of *Salix* spp. and herbs,

Table 2. Number of species and percentages of certain forage groups in the seasonal diet of moose in the Russian Far Northeast.

Forage group	May-June		July-August		Sept.-Oct.		Nov.-April	
	No.	%	No.	%	No.	%	No.	%
Twigs of trees, shrub and low shrubs	25	24.8	23	22.8	27	26.7	25	24.8
Herbs	9	8.9	58	57.4	57	56.4	19	18.8
Tree bark	3	2.9	-	-	1	0.9	3	2.8
Mushrooms	-	-	3	2.9	2	1.9	2	1.9

especially aquatics. In the boreal taiga subzone of the Omolonsky basin, herbs made up to 85.7% of the diet in summer while in the Anadyrsky region woody plants constituted 72.7% of the observed diet. The observed diet of the 2 populations is similar throughout the year in choice of woody plants but considerably different in herbs. In autumn, woody plants were 81.8% of the diet in both regions and remained close in percent composition during other seasons. In summer, both moose populations had almost equal parts of herbs in their rations: 88.9% for the Anadyrsky population and 85.7% for the Omolonsky one. But in autumn, especially in September, herbs remained high in the observed diet at 97.7% of observed feeding sites in the Anadyrsky region, while in the Omolonsky population herbs declined to 47.2%, mainly because many ponds and lakes were frozen, preventing use of aquatics. Bark made up 1.0% of the observed diet.

Similarity of summer and winter diets were also noted by Egorov (1971), who considered the differences to be related to differences in subspecies of moose. However, Sablina (1955, 1970) attributed this to variation in forage availability. Substantial differences in geography and climate in the Anadyrsky and Omolonsky basins and in soil and hydrological conditions cause the vegetative composition in moose habitat in the regions to be highly variable.

There are considerably fewer lakes in the Omolonsky basin than in Anadyrsky, where the more prevalent mountain landscapes create higher plant diversity. By contrast, the Anadyrsky basin, except for some tributaries, is lowland where there are many lakes, herb and sphagnum marshes, oxbows and streams with herbs abounding along their sides and forming marshy meadows. Approximately 600 species of herbs keep green until snowfall in this basin. In the Kolymsko - Indigirsky lowlands, as well as at Anadyrsky, shallow lakes and marshes contain extensive marsh plant communities. In other areas where smaller taiga and tundra ponds prevail, moose use them until temperatures decline to 4.6°C when mosquito activity is much reduced (Zheleznov 1975). A few moose move into open tundra - grass and herb marsh communities, and to the ecotone with large shrub communities, during rut.

Nutrition in Autumn and Winter

In autumn, herbs disappear from the moose diet. In late September and October, moose use large shrub communities of low density along oxbow lakes and old bends, dried streams on flooded terraces, where small natural meadows occur. Male moose use these areas prior to rut, where they may move 0.5-0.8 km/day searching for aquatic plants and shrubs. One rumen from a large male contained 15-18% twigs by volume. Moose remain in these areas when snows deepen to 15-20 cm when they use Cyperaceae, Equisetaceae, and Gramineae. Chemical composition of the plants remains similar through winter (Temnoev 1939; Zubkov 1949; Kovakina 1952, 1958; Tikhomirov 1959).

Moose are able to paw through snow to seek forage throughout the winter in the Omolonsky and Anadyrsky basins, mostly near river and valley terraces. I also observed moose pawing through snow in the upper reaches of the Kolyma. Under snowless and windless weather moose travel little and paw out areas as large as 0.5-1 ha. Moose seek out Cyperaceae, Gramineae, and other species. Egorov (1971) also observed this phenomenon on the marshes of the Indigirskaya and Kolymskaya lowlands.

The autumn diet includes 17 species (56.7%) of Cyperaceae of 30 in the area, or 25.8% from the total number of herbs. Some constitute up to 6.7% of the diet when

winters are mild with little or no snow. In deep-snow winters moose seek out deciduous forests with undergrowth of *Alnus, Salix, Sorbia, Ribes,* and other shrubs, and larch forests. At night they visit stands of young *Chosenia arbutifolia and Populus suaveolens.* Distances traveled at that time may be as long as 2-3 km. Bark is eaten more frequently, but made up only 4.5% of the total observed diet. Stomach contents of moose taken in April contained significant amounts of mushrooms. In winter moose paw out mushrooms as well as green plants.

When snow cover reached 0.5-0.6 m, moose used smaller areas and stayed in groups of 3-5, sometimes up to 7. In the areas where floodplain forests are narrow, young trees showed evidence of severe browsing, especially on islands. Moose do not use island centers as much as the peripheries.

Moose moved readily during mild winters, when snow cover was 0.4-0.6 m, and daily distances traveled were 30-45% longer compared with winters when snow thickness reached 0.6-0.7 m. During mild winters, especially in December-February, moose concentrated in tall shrub communities. In mid- March 1984, in the Anadyrsky basin, 700 of 1,732 (40.4%)moose observed were in large shrub communities and 25.1% were in the taller *Poplar-Chosenia* communities. During such winters the animals did not move much and fed on shrubs exclusively, eating stems up to 8-10 mm diameter. Woody plants constituted 72.7% and 50.9% in the Anadyrsky and Omolonsky basins respectively. Herbs did not exceed 35.6% for the Anadyrsky basin moose and 8.8% for the Omolonsky basin ones. On the Anadyrsky lowland, moose occupied extensive valley forests where lakes and marshes alternate with shrub thickets on terraces, and where herbage mostly consists of Cyperaceae, Equisetaceae, and Onagraceae.

DISCUSSION

Year-long, trees and shrubs dominated the moose diet in northeastern Russia. In summer, herbs increased in the observed diet. In the Omolonsky and Anadyrsky basins, *Salix* spp, *Populus* spp. *Ribes* spp., and *Vaccinnium* spp. were the main components of the animals' ration. Potamogetonaceae, Cyperaceae, Equisetaceae, and Gramineae, were important forages during the growing season. A great variety of herbage is observed to be used, but woody and herbaceous species are preferred. *Salis pulchra* constituted 51.7% of the total observed diet, *S. krylovii* 55.4%, *Chosenia arbutifolia* 67.9%, and Cyperaceae, Gramineae, and Onagraceae constituted 14.3 to 35.7% of the observed diet. Mushrooms of the genus *Russula* were consumed most often.

The diets of moose in Chukotka and Yakutia were similar relative to main forage groups according to season, except for herbs in autumn. Egorov (1965, 1971) reported that woody plants made up 91.4% of the observed winter diet of moose inhabiting the Yakutia and Verkhoyanie, while in the Indigirka basin woody plants consituted 46.4% of the observed diet. *Equisetum* spp. and Gramineae constituted 8.6% of the diet in Yakutia and Verkhoyanie and 53.6% of the diet in the Indigirka basin. The proportion of herbs is high in the diet of moose in lowlands of northeastern Russia in winter.

Diets of moose in the northeastern part of Russia resemble those for moose in western Canada and central Alaska. Yearly diets of moose in North America include 105 species (Peterson 1955), 3 woody species more than observed taken by moose in far northeastern Russia. Moose in North America use numerous aquatic species but have not been observed to use mushrooms,

grasses, and mosses to any extent. Feeding on water-marsh plants was similar for moose of the far northeast and of North America, when marshes and lakes were favorite feeding areas. Estimates of winter twig biomass for the far northeast of Russia (Chukotka) suggest that up to 6,000-6,500 moose could be supported. At present, moose do not exceed 3,200, animals with not more than 2,100 individuals in the Anadyrsky population and 1,100 animals in Omolonsky. The Chukotka moose population is considerably lower at present than it could be.

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REFERENCES

CHERKASOV, A.A. 1962. Notes of a game naturalist.. Academy of Sciences of the USSR, Moscow. 503 pp.

DOMNICH, V.I. 1983. Behavior and nutrition of moose at lakes of the right bank Kolyma in summertime. MOIP Bull. Biology Dept. 88(6): 50-61.

EGOROV, O.V. 1965. Wild Ungulates in Yakutia. Moscow: Nauka. 258 pp.

_____. 1971. Moose. Mammals of Yakutia. Moscow: Nauka. pp. 551-567.

JOYAL, R.and B. SCHERRER. 1978. Summer movements and feeding by moose in Western Quebec. Can. Field-Nat. 92: 252-258.

KOVAKINA, V.A. 1952. On wintering of some grasses in the Far North. Botanical Magazine 37:694-698.

_____. 1958. Biological peculiarities of some wintergreen plants of the Far North Botanical Magazine 43:1326-1332.

LABUTIN, Y.V. 1976. Does the moose dive? Hunt and Hunting Management 4: 10-11.

NASIMOVICH, A.A. 1948. Experience in mammals' ecology studies by winter tracking. Zoology Magazine27:371-372.

PEEK, J.M. 1974. A review of moose food habits studies in North America. Naturaliste can. 101:195-215.

PETERSON, R.L. 1955. North American Moose. University of Toronto Press, Toronto. 280 pp.

RAKOV, N.V. 1965. Materials on distribution and ecology of moose in the Amursko Ussuriisky krai. Biology and Hunting for Moose 2:28-65. Moscow: Rosselkhosizdat.

RITCEY, R.W. and N.A.M. VERBEEK. 1969. Observations of moose feeding on aquatics in Bowron Lake Park, British Columbia. Can. Field-Nat. 83:339-343.

SABLINA, T.B. 1955. Ungulates of the Bielorussian virgin forest. Moscow: Leningrad. 192 pp.

_____. 1970. Evolution of the moose digestive system. Moscow: Nauka. 176 pp.

SOBANSKY, G.G. 1980. Moose and marals at the mountain lake of the North Kazakhstansky Altai. Ungulate Fauna of the USSR. Moscow: Nauka. pp. 309-311.

_____. 1981. Moose and marals at mountain lakes of Altai. MOIP Bull. Biology Report 86:29-35.

_____. 1988. Game animals of the mountain Altai. Novosibirsk: Nauka. 156 pp.

TEMNOEV, N.N. 1939. Wintering of overground organs in some herbs of the Far North. Works of Polar Agriculture, Farming and Game Management. SRI. Reindeer Breeding Series 4: 67-88.

TIKHOMIROV, B.A. 1959. Interrelations of wildlife and vegetation cover of tundra. Moscow: Leningrad: Publish.

House of the USSR SA. 104 pp.
TIMOFEEVA, E.K. 1967. To the method of winter moose ecology. M. Rosselkhozizdat, pp. 257-266.
ZHELEZNOV, N.K. 1975. Snow sheep of Chukotka. Increasing of fur-farming and game fauna productivity. Works VSKHIZO 104: 67-74. Moscow.
_____. 1976. Materials on moose distribution and ecology in Chukotka. All Union Agricultural Institute Works, Moscow Is. 119: 61-67.
_____. 1990. Wild ungulates of the USSR North East. Vladivostook: FEB SA USSR. 479 pp.
_____. 1994. Wild ungulates of the North East of Russia and their spatial structure: Dissert. auth. thesis of Biology Sciences doctor. Russia State Agricultural Univesity, Moscow. 61 pp.
ZUBKOV, A.I. 1949. Chemism dynamics of some Arctic plants. Problems of Arctic 2:99-101.