POPULATION ECOLOGY OF THE MOOSE IN THE RUSSIAN SOUTHERN TAIGA

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ABSTRACT: The historical occurrence of moose in the Russian southern taiga is described based on experience in the Kostroma Region. Sex-age composition, fecundity, and productivity of moose in taiga and mixed forest areas are compared. Variation in moose density is considered with reference to the intensity of hunting and predator numbers.

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Moose are an important source of protein throughout many portions of the USSR. This is particularily true within the Kostroma region of the Russian southern taiga where moose provide about 1% of the meat supply. The purpose of this paper is to review historical population trends in the moose, wolf (*Canis lupus*), and brown bear (*Ursus arctos*) populations of the Kostroma region, and provide data concerning moose sex-age composition, fecundity, behavior, and their recent distribution.

STUDY AREA

The study was conducted at the Kostroma Taiga Experimental Station of the Institute of Ecology and Evolution, Russian Academy of Sciences during the period 1970-1990. The Kostroma Station, encompassing 70,000 hectares is situated 600 km north-east of Moscow and within the southern taiga forest, about 50 km east of the boundary with more southerly mixed forest (Fig. 1).

The southern Russian taiga is characterized by harsh climate and sparse soils, suitable for the growth of timber but not conducive to farming (Table 1). The narrow flood plains of rivers (6% of forested areas) provide little summer forage for moose. However, winter foods are abundant, averaging 320 cgs.

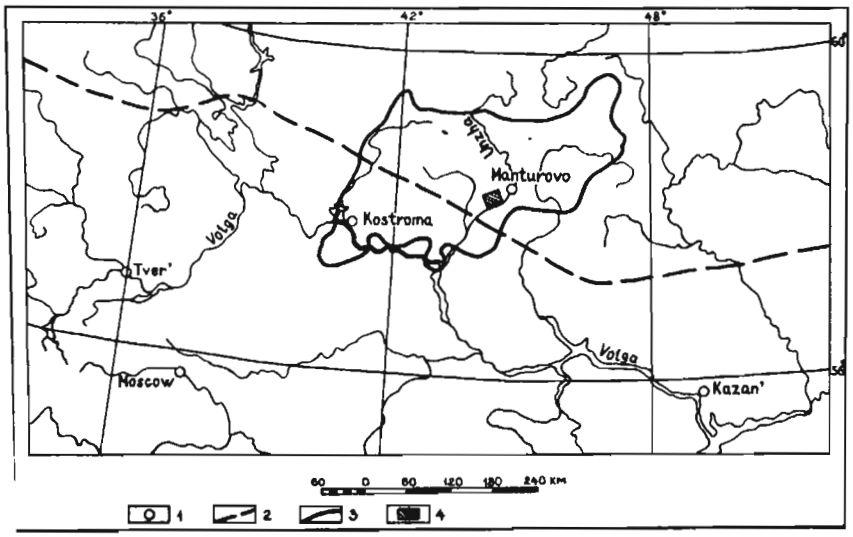

Fig. 1. Geographical location of the Kostroma Taiga Experimental Station. (1) = location of large towns; (2) = boundary between the the mixed forest southern taiga zones; (3) = border of the Kostroma region; (4) = location of the Kostroma Taiga Experimental Station.

Table 1. Landscape - ecological features of the Kostroma Taiga Experimental Station.

	Jan.	Mar.	May	Jul.	Sept.	Nov.
Mean temperature	-11.6	-6.0	+10.8	+17.9	+9.4	-3.4
Precipitation (mm)	24	25	45	82	63	38
Snow cover (cm)	43	>55	-	-	-	1

Soils podzilic, sod - podzolic

Geography rare rivers, streams, lakes; narrow valleys of streams.

Forests on sands and loamy sands- pine forests;
on loams - spruce and deciduous forests

Forest types	Wetting	Age	Forest area (%)
Pine	Dry	Mature	7.9
Pine	bogged	Mature	2.7
Pine	bogged	Young	16.3
Spruce	Dry	Medium, mature	11.8
Spruce + Birch + Aspen	Dry	Medium, mature	3.0
Spruce + Birch + Aspen	Dry	Young	16.0
Aspen + Birch	Dry	Mature	36.5
Brich + Aspen	bogged	Mature	5.8

of dry mass per hectare (based on measurements on a 250 ha sample) and include the shoots of willow (*Salix sp.*), mountain ash (*Sorbus aucuparia*), aspen (*Populus termula*), pine (*Pinus silvestris*), juniper (*Juniperus communis*), silver fir (*Abies sibirica*), the bark of aspen, mountain ash, and pine.

METHODS

The distribution and abundance of moose throughout the area was determined by recording observed moose tracks in snow and in mud, and by intensive helicopter census. Because no moose were marked, we do not know if our observations represent sedentary or migratory moose, or both. Moose killed during the 1987 moose hunting season were aged by counting cementum annuli according to methods described by Sergeant and Pimlott (1959). Fecundity and productivity were determined from information provided by hunters. Fluctuations in moose numbers since 1850 are provided by using data from Jurgenson (1935), Kirikov (1960), and the Kostroma region hunting management records since 1966. Records from the latter source were also used to estimate bear and wolf numbers since 1970 and 1978, respectively.

RESULTS AND DISCUSSION

Annual moose distributions based on track counts over the past 14 years at the Kostroma Station were variable. Areas frequented most by moose were composed of mature coniferous-deciduous forests in the upper reaches of rivers. This habitat type was similar to that described by Flerow (1934) as pristine moose habitat. Young seral stages of aspen, willow, and pine created by fire or logging activities have been used for 5-7 years or longer, apparently because they contained abundant forage. As the forest "disappeared from under the snout" (as game biologists say in Russia), moose left these areas. The most suitable winter habitat now occurs along the boundaries between tall, mixed or purely coniferous forest and low forest. Browsing occurs in the latter, while resting occurs in the mature for-

est where moose apparently prefer an observation radius of 100 metres on at least three sides. The length of time that individual moose remain in particular areas and other characteristics of home range utilization are described in Table 2. During summer, moose occur in dense valley forests along streams.

I also examined moose useage during the rutting season for 3 years within a 3.5 km plot of young and middle-aged rare pine stands where 63 shed antlers and numerous trees rubbed by bulls have been found. These observations suggest that there may be special, rutting places used repeatedly by moose.

Generally, historical fluctuations in moose densities within both mixed forests and in southern taiga were similar between 1966 and 1990 (Fig. 2). However, beginning in 1980, a decrease occurred in the southern taiga moose population while numbers in the mixed wood forests continued to grow. The decline within the southern taiga may be attributable to recurring forest fires over large parts of the area (an extensive fire occurred in 1972), while in the mixed forests, fires were relatively unimportant. Hunting did not appear to be an important factor since harvests were relatively stable. Annual harvests in the taiga part of the Kostroma region increased slowly from an estimated 3 to 10% of the population (Fig. 3). It is estimated that poaching amounted to about one-third of the legal harvest.

Fluctuations in the wolf population tended to follow those of moose. Bear numbers increased slowly and appeared independent of moose numbers (Fig. 4). Based on predator and moose population trends, I suggest that predation has resulted in a stable moose population in the taiga region. Predators remove most of the off-spring while man takes a relatively small proportion of the population. In such a case, curtailment of licensed hunting

Table 2. Characteristics of home range utilization.

Type of utilization of home range	Characterization in relation to beddings	Foraging pattern	Track characterization
Stops en route		en route	Tracks or path in direction.
Stop (foraging & & beddings)	Single rest	Single foraging	Network of tracks, which is not dense; routes of individual moose can be traced.
Little camp	Double rest		A sparse network of tracks, One can follow the routes of individual moose.
Middle camp (up to 24 hours)	Up to 5 times of rest during 24 hours	Foraging paths reach dozens to hundreds of meters from bedding sites	Network of tracks; only the plot and time of feeding of a single group can be determined.
Long camp (up to 3 days)	Beddings for 1 - 3 days		
Flat (3 days - 1 month)	Numberous bedding for many days	Mass foraging for many days	Set of path, where the track of one moose can be followed for many meters.
Region (joint dwelling of several groups; diameter of plot up to 5 km)			

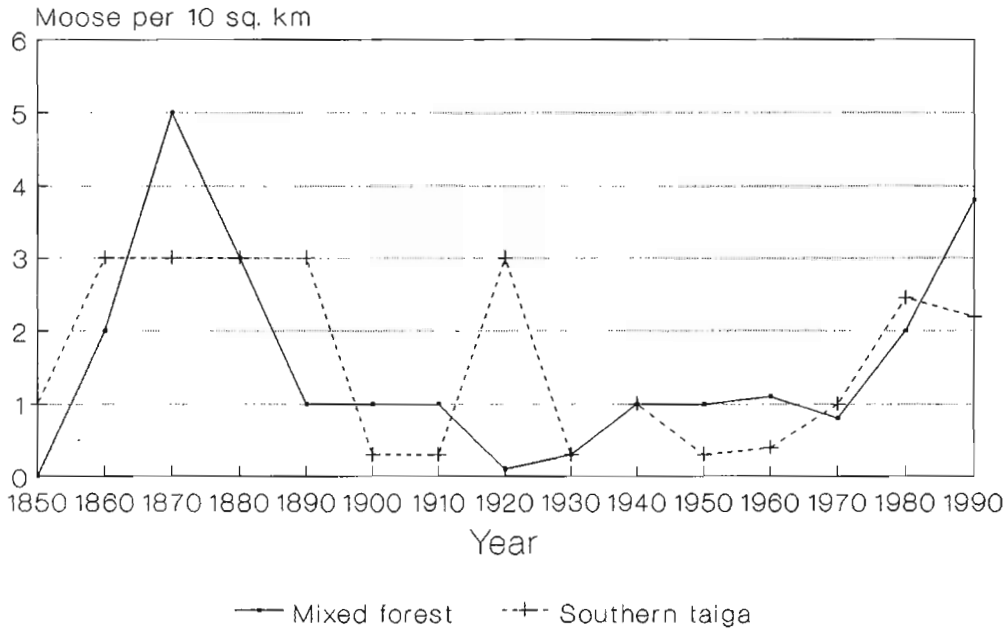

Fig. 2. Trends in moose density in the mixed forest and the taiga portions of the Kostroma region, 1850 - 1990.

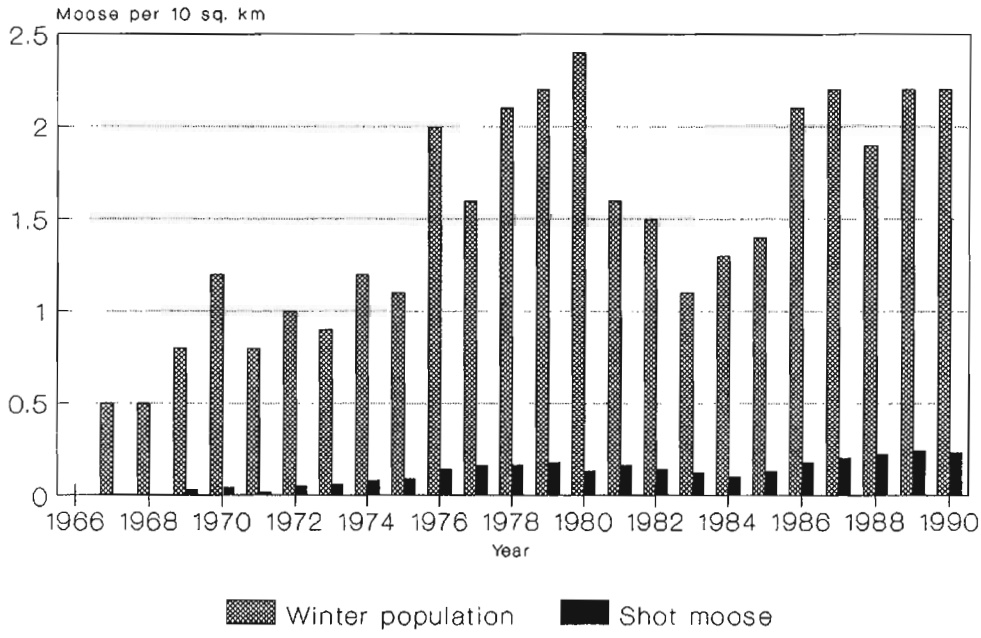

Fig. 3. Comparison of moose abundance and moose harvest in the southern taiga portion of the Kostroma region.

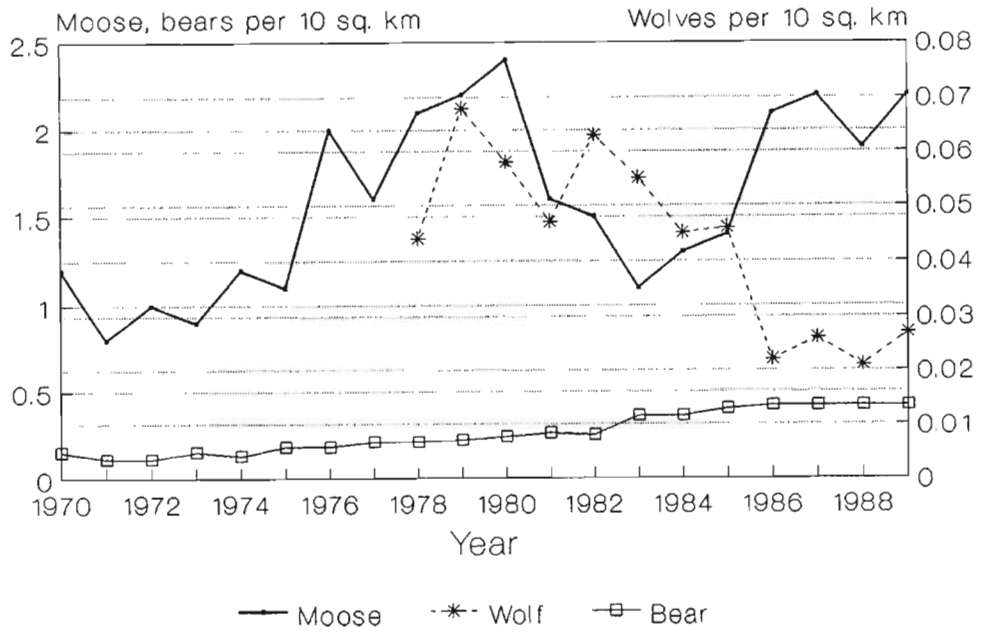

Fig. 4. Trends in moose, wolf, and bear densities in the southern portion of the Kostroma region.

does not result in a moose population increase. The moose population has remained stable or is growing very slowly.

I discerned noticeable differences in sex-age composition, fecundity, and reproductive rates of moose between mixed forests and taiga areas. Age ratios of moose <5.5 years were not different between taiga and mixed forests but taiga areas contained more older moose than mixed forests. During autumn 1987, taiga cows averaged 0.74 embryos/cow and 0.55 calves/cow while in mixed forests cows averaged 0.69 embryos and 0.39 calves/cow. The differences were undoubtedly associated with the taiga population being "older".

CONCLUSIONS

Management officials believe that current moose population densities and productivity are unsatisfactory within the Kostroma Region. To improve this situation it is necessary to develop a management strategy which should include regulation of annual harvests including closures and possibly predator management programs. Management will become increasingly more difficult because much of the mature forest has been logged between 1940 and 1980. However, in my opinion, new forestry policies which involve planting spruce and pine following logging of mature timber will create favorable moose habitat.

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