MOOSE AND FOREST PROBLEMS IN RUSSIA

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ABSTRACT: This article presents an analysis of the moose–forest relationship in Russia characterized by utilization of land by humans and its consequences for moose and the forest. It provides a general overview of the research approaches regarding Russia's damaged forests by moose. In the early 1950s, the moose population increased sharply, primarily due to enlargement of the cutover area and the ensuing increased forage resource. Devastation to pine and oak are emphasized amid a backdrop of damage to silviculture that cost millions of rubles. Other northern countries were undergoing similar destruction by moose to their forests. Three main research approaches are distinguished: determination of the damage by moose to stands, estimation of the effects of moose on the structure of forest phytocenoses, and the effects of moose on the productivity of particular plant species and forest phytocenoses. This well–documented article correlates various moose population densities with specific effects on different ecosystems and emphasizes the fact that trophic activity of moose is one of several factors affecting the structure and succession of forest phytocenoses of various natural zones.

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In the USSR, a moose and forest problem originated in the early 1950s, when the moose population increased sharply, primarily due to enlargement of the cut over area and, subsequently, the increased forage resource. In this situation the moose began to detrimentally affect young forest growth and regrowth opportunity, especially those of pine and oak. The damage inflicted by moose on silviculture was estimated at millions of rubles. A negative effect of the moose on the forest was also recorded in other countries, such as Sweden and Norway (Yurgenson 1979, Filonov 1983).

Analysis of the studies conducted in the USSR on the moose and forest problem shows 3 main approaches: (1) determination (%) of the degree of damage by moose to forest stands; (2) evaluation of the effect of moose on the structure of forest phytocenoses and succession processes; and (3) investigation of the effect of moose on the productivity of particular plant species and forest phytocenoses. These 3 main approaches to a certain extent reflect the history of the development of research into estimation of the functional role of moose in forest biocenoses. In most studies of the first approach, the damage estimate of moose on the forest was based on the criterion of the level of damage to the shoots of trees (%). However, on the basis of such data, the effect of moose on the productivity of forest phytocenoses and related components cannot be estimated. Nevertheless, an examination of studies on this subject is valuable to address the large body of evidence already collected from these data.

An inverse relationship between the area of pine plantations and the rate of their damage by moose was established; i.e., the less area of pine plantations on cutovers being overgrown, the greater they are affected by moose (Dinesman 1961). It follows that plantations should have a great area to resist the trophic pressure of moose. These results were supported by further studies. In fact, a number of authors (Kozlovsky 1960, Kaletskaya and Kudinov 1987) revealed that a ratio of 20–30 ha of forage grounds (forest plantations) per moose reduces the detrimental role of moose to a minimum and, conversely, a ratio of <10 ha per moose sharply increases the damage to plantations by moose. To some degree this index indicates the expected effect of moose on forest plantations. For instance, in the Nizhny Novgorod Region, the area of young pine per moose is 112 ha, while in the Novgorod Region, it is only 4.3 ha (Chervonnyi 1975). Naturally, in the Novgorod Regions the effect of moose on forest plantations is more substantial.

Judging from the fact that dense plantations of pine are damaged by moose to a much lesser extent, Borodin (1959b) proposed a biological approach to pine protection from moose through an increase in the density of its plantations.

Numerous authors (Borodin 1959a, Dinesman 1961, Kheruvimov 1969, Padaiga 1980, Smirnov 1987) have demonstrated that intensive trophic activity of moose delays the growth of pine, oak, ash, aspen, birch, fir, and other species, which is reflected in the quantity of timber. Subsequently, a number of researchers revealed that the intensity of forest damage by moose is a function of their population density. In fact, in small forest massifs of the Tsentralno–Chernozemny Reserve, the trophic pressure of moose is fairly heavy (Gusev 1988). It is understandable that the degree of moose effect on forest plantations largely depends on the absence, in some cases, of a clear cut relationship between the population density of moose and plantation productivity over large areas (Kuznetsov 1980).

A large body of evidence was obtained on the development of stands under the effect of moose in reserves of the USSR; Prioksko–Terrasny, Oksky, Darvinsky, etc. (Kaletskaya 1959, Kozlovsky 1960, Timofeeva 1974, Chervonnyi 1975, Dunin 1975, Zablotskaya and Zablotskaya 2002). The effect of moose is one of a series of factors affecting the health of the stand. In mixed plantations, it is important that such factors as growth conditions, the ratio of different trees, and the distribution of available forage should be taken into account. Necessary cutovers can promote the formation of high–quality timber. The recent discussion on the moose–forest problem in the journal Okhota i Okhotnichye Khozyaistvo (Hunting and Game Management) demonstrated that there are many problems yet to be solved on rational use of moose and the forest (Pavlinov 1983, Dunin 1984, Perovsky 1984).

A second direction of research is that it is known that moose promote replacement of the main species of regrowth and underbrush and the specificity of the effect of moose is associated with the features of succession in a particular region. For instance, on Valdai, as a result of the effect of moose, there occurred gradual replacement of pine by deciduous trees and spruce. Since spruce forests form under natural succession, there are grounds to believe that the moose promoted acceleration of this process. Under conditions of the southern taiga, moose under different population density exert a dissimilar effect on the development of forest stands. When moose numbers are low, spruce–birch stands develop, but when moose numbers are high, primary spruce stands recover. An excessive population of moose degrades stands (Smirnov 1987, Abaturov and Smirnov 2002). In another region in Tulskie Zaseki, according to our data, moose damaging oak trees promote acceleration of the growth of ash, in particular the linden and filbert. There, the moose acts as a factor promoting the development of shady linden forests. Thus, the trophic activity of moose is one of the factors affecting the structure and succession of forest phytocenoses of various natural zones.

Another approach to the moose–forest problem is associated with the investigation of the role of moose in the productivity of particular species of arboreous and herbaceous plants and phytocenosis. The main data were obtained through comparison of the state and productivity of plants under the effect of moose and in isolation from them. Under conditions of forest–steppe, moose affect the growth and development of broad–leaved forests and decrease their productivity (Zlotin and Khodashova 1974, Gusev 1989). In Tulskie Zaseki, oak and ash respond differently to the effect of moose. Under conditions of a constant effect of moose, the oak reduces its productivity even under a small level of removal (13%). Conversely, the ash is more resistant to removal of its phytomass by moose, which appears to be due to the biological properties of this species; on average, the annual increment of the leaf phytomass exceeds tenfold the respective increment of shoot phytomass. The shoots of ash are protected by the mass of foliage, and, hence, the moose utilizes them to a less extent.

In Valdai under conditions of the southern taiga, the annual increment in the Scots pine in isolation was twice as high as in the pines accessible to moose; the admissible removal of annual shoots under which productivity is not reduced is close to 50%. It should be noted that removed phytomass of the pine is used by the moose fairly effectively and forage remains about 5%. It should also be emphasized that the state and productivity of pines is a function of not only the effect of moose but also of a set of other factors. For instance, the productivity of pines in an elevated plot is twice as high as in a lowland bogged area, despite the fact that the trophic pressure of moose in the former case is tenfold higher (Kuznetsov 1980).

The effect of moose on spruce is determined to a great extent by penetration of insect pests through injured parts of the stalk and infection by timber rots, which results in disintegration of the spruce layer of the stand rather than by removal of regrowth (Smirnov 1987). Willow and mountain ash can sustain 70–80% of removal of annual increment over many years, the productivity being maintained at a relatively constant level. The mountain ash is more resistant to phytomass removal by moose than birch and willow; favorite forage of moose is still moose resistant (Kuznetsov 1980, Chernyavsky and Dubinin 1989).

A cycle of observations over the natural response of arboreous plants to removal of their increment by moose is supplemented by data on experimental removal of phytomass in the pine and oak, and aspen (Smirnov 1987). It was demonstrated that the productivity of the pine depends not only on the amount of removal of the increment phytomass but also on the method by which it is removed; i.e., removal of individual shoots does not bring about as sharp a reduction in productivity as does removal of the same amount of phytomass from each shoot. The moose normally browse only a part, about one third, of the shoots; it chooses the most judicious method of using the increment. Also, as shown by defoliation and cutting the shoots, aspen sensitivity to removal of shoots can serve as a good indicator of the state of forage resources of moose (Smirnov 1987). In general, we can conclude that deciduous trees, especially those that have root shoots, sustain greater trophic pressure by moose than coniferous and those without shoots.

How moose actively affect the productivity of forest phytocenosis is not fully understood; however, the importance of this line of research is beyond doubt. We have demonstrated in Valdai that such characteristics as annual increment, the long–term reserve of phytomass of herbaceous vegetation and shrubs, and the annual increment of heath under the effect of moose exceed the respective parameters under conditions of isolation. The increase in productivity of the pine in an open area (in a "range") appears to be compensated for by an increase in the total increment of herbaceous plants and shrubs at the level of phytocenosis. However, to get the total balance of phytocenosis productivity, a number of other parameters are needed such as increment of the stalk loss due to trampling, etc. But still there are grounds to believe that moose, affecting the value of annual increment in some individual plant species, can to a considerable degree reduce the productivity of entire phytocenoses (Kuznetsov 1980).

Thus, the line of research in question makes it possible to estimate the activity of moose as a component of forest ecosystems. The ecosystem approach regards the activity of moose as the same damage inflicted on the forest, since primary production will be transformed into secondary and the very notion of "damage" does not exist in the biological sense. Conversely, the silvicultural approach presupposes obtaining high–quality timber and, hence, the moose and forest problem becomes realistic. In this connection, it is not by chance that the efforts of both zoologists and silviculturalists are aimed at investigating methods of forest protection from moose. The most harmless and accessible are the biotechnical methods, such as supplemental feeding, planting of fast–growing shrubs, and shoot cutting, etc. However, when moose numbers are high, these methods yield no positive effect. Presumably, under these conditions it would be expedient to use such a powerful method of moose population control as removal. But in this country, only 10–12% of the moose population is removed, which is obviously insufficient. It will be remembered that in Sweden they removed 40–50% of the population (Dezhkin 1983). Of interest are the approaches to the investigation of the intrapopulational structure and its role in the regulation of moose numbers (Baskin 1984).

Mechanical methods, the exclosure of commercially important arboreous species, can be the most effective, but they are associated with great economic expense because exclosures must be efficient to achieve the desired outcomes. The optimal methods for protection of forest from moose depend on particular conditions in specific regions, and their application should be integrated. In recent years chemical methods of forest protection from moose have been developed (Martynov 1980). The application of repellents can in some regions be very promising, but, unfortunately, there are no data available on the genetic control of their application. Thus, through the efforts of scientists, the set of methods of forest protection from moose increases, but their implementation is lagging behind. It can be hoped that increasing interest in the problems of conservation of the natural environment will stimulate the solutions for these practical problems in the field of moose ecology.

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