MONITORING OF MOOSE-FOREST INTERACTIONS IN ESTONIA AS A TOOL FOR GAME MANAGEMENT DECISIONS

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ABSTRACT: This paper reviews several big fluctuations in moose (*Alces alces*) numbers and related problems in Estonia during the last century. The biggest conflict appeared during the period 1960 – 1980, when the moose population achieved its highest density. The result of the overpopulation of moose was extensive forest damage. The establishment of a monitoring system and its acceptance by game management authorities at the beginning of the 1990s contributed to the improvement of the situation. The monitoring includes both the estimation of moose population parameters and estimation of moose influence on forest regeneration. Current moose numbers match the optimal population level outlined in the Estonian Environmental Strategy, approximately 10,000 animals, and forest damage has decreased.

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Estonia is a small country, rich in forests and bogs, situated on the shores of the Baltic Sea. Almost 50% of its surface is covered with forest, providing moose (*Alces alces*) with excellent natural habitat. At the same time, forestry is of great importance to the national economy. The forest is a resource shared by both man and moose, and sometimes conflicts arise. Through the ages Estonia has experienced several undesirable fluctuations of its moose population, a phenomenon shared throughout the Baltic region (Baleishis et al. 1998). Maximum populations have been pleasing to hunters but disturbing to foresters and vice versa. It is now commonly understood that the most important means for avoiding such conflict is adequate information concerning both the moose population and the condition of the young forest. Until recently, moose population data (official survey data) were based only on the reports of hunters and were very subjective. Since 1994, the monitoring of the moose population has been financed both by the state budget and by the state Center for Environmental Investments.

DEVELOPMENT OF MOOSE POPULATION AND CONFLICTS

The first conflict between hunters and forest owners in our territories started at the end of the 19th century, when the moose population was high. The landowners split into two camps: those who received a large share of their income from the timber market, and those who were passionate hunters. Although the landowners owned the hunting rights, their efforts to regulate moose numbers were not successful. Instead, the population was reduced drastically due to poaching by peasants and soldiers during the Revolution of 1905 and the First World War (Rootsi 1998). By 1924, only about 25 moose were estimated to exist in the newborn Republic of Estonia (Teino 1939). Several decades of peace between hunters and foresters followed.

After WWII, a rapid increase in the moose population started in Estonia and in neighboring regions (Haagenrud et al. 1987, Smirnov 1987, Baleishis et al. 1998). In Estonia, the growth of the moose herd (Fig. 1) occurred due to the following conditions: (1) extensive post-war clear-cuts and reforestation of clearings; and (2) a significant decrease in the number of the main natural enemy, the wolf (*Canis lupus*).

The unprecedented increase in the number of moose was not reflected in official statistics. At the end of the 1970s, when the moose population was probably bigger than ever, hunters counted about

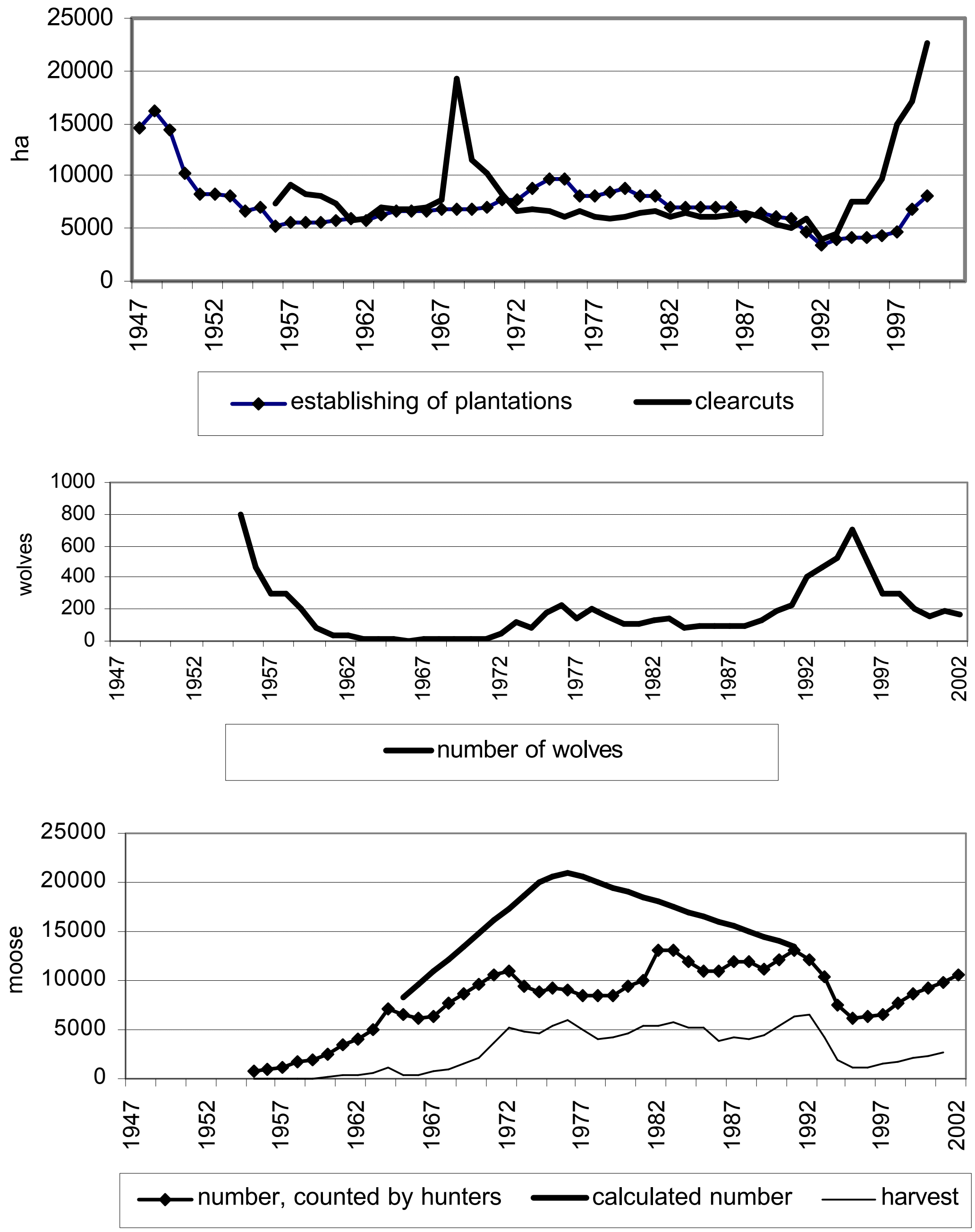

Fig. 1. The size of the moose population in Estonia in relation to the number of wolves and to the establishment of forest plantations and area of clearcuts.

9,000 individuals annually (Fig. 1). According to our calculations and the opinion of several competent hunters, there were probably at least twice as many moose at that time. Otherwise, it would not have been possible to have killed an average of 4,800 moose during the hunting season (Fig. 1).

By the mid-1970s the high number of moose was coupled with a marked decrease in the area of young pine plantations. In 1965, there were 60,000 ha of 10-20 year old pine stands and 6,000 – 8,000 moose. By 1975, the area of similar stands was 33,000 ha and the moose numbers had at least doubled. Obviously, the young pine stands suffered from severe damage. At the end of the 1970s, 21,000 ha of age-class I young pine stands were damaged by moose (Örd and Tõnisson 1986).

In this situation, the only solution could have been the decisive reduction of the moose-population, but the hunting quota remained the same. As we know, a similar situation also developed in Fennoscandia in the mid-1980s. Authorities there reacted quickly and the problem was more or less solved (Haagenrud et al. 1987). This was not the case in Estonia. No state-organized monitoring system existed in those days, and hunting officials had to rely on hunters' observations. The hunters were not interested in or motivated to have a higher quota due to an existing policy that dictated a large portion of hunted moose had to be handed over to the state. In addition, a state restriction on rifle ownership meant most hunters had to use shotguns, thus impacting their ability to bag a moose. As a result, hunters knowingly reported lower population numbers to the hunting officials.

Fearing forest damage by moose, foresters began to cultivate more spruce than pine, which resulted in a decrease in the area of young pine stands (Paal 1996). At the end of the 1980s, more serious damage became evident in the form of bark peeling of middle-aged spruce (Randveer and Heikkilä, 1996). Moose had always fed on spruce bark to a certain extent, but it had never been dangerous to spruce silviculture. Now, the damage reached catastrophic dimensions in some regions. According to the inventory organized by the Estonian Forest Protection Service in 1991, serious bark stripping was found in 18% (12,800 ha) of middle-aged spruce stands. In order to decrease the forest damage, moose hunting was intensified considerably at the request of the forest administration. The largest numbers (6,589) of moose were shot legally in 1992. Actually, by that time, the number of moose had already decreased and "the sons were punished for the sins of their fathers." Socio-economically, the early 1990s was a difficult period in the Baltic States. As always, in hard times, the number of wolves rose abruptly (Fig. 1) and poaching increased. Thus, the cumulative effects of several factors, including increased hunting quotas, poaching, and predation, led to an undesirable decrease in the number of moose.

MONITORING

The Estonian moose population has been studied since the beginning of the 1960s. For a decade it was done by Dr. Harry Ling, whose work has been summed up in the monograph "The structure and dynamics of the population of moose in Estonian SSR" (Ling 1977 a, b). Among other things, he showed the inadequacy of official survey data. Unfortunately, his recommendations were not applied in game management practice. In the 1990s a new method of monitoring moose was developed based on the experiences of Estonia, the other Baltic States, and Fennoscandia. The monitoring method includes estimating moose numbers and other population parameters as well as estimating the impact of Cervidae (mainly moose) on forest regeneration.

The main aim of monitoring is to estimate moose population density, sex, and age structure, annual growth rate, and some other parameters. Since 1991, the estimation of the number of moose is made by analyzing hunting data coming from the hunters and checking them against results from winter pellet group counts from at least 6 permanent monitoring areas, following the methods provided by V. Padaiga (1970) and V. Chervonnõi (1973). Some local hunters' societies use this pellet-count method as a main tool to count moose. We used the pellet group counting method for the first time in Lahemaa National Park in the early 1980s. There, the population density estimated by this method was 2-3 times higher than the hunters' estimation (Randveer 1986). It is quite probable that this was the case throughout Estonia. In 1991, the two estimates were nearly identical but exhibited very different growth rates. We estimated the number of moose at 12,000 after 10-15 years of decline instead of an increase, as could have been erroneously deduced from the official survey data (Fig. 1).

Since 1991, the game management authorities have used the monitoring data to set the moose harvest quota. Other population parameters, estimated annually are sex distribution and proportion of calves in the population (based on 2,000 – 8,000 observations of moose every autumn), and age distribution (by studying 1,000 – 2,000 lower jaws of hunted adult moose). These data are considered when determining the harvest quota and its structure. The population, sex and age structure, and annual increase estimates are applied to a model developed in Finland (Nygren and Pesonen 1993). The model predicts the size and composition of the moose population the next fall and recommends a harvest quota.

Additionally, three ways of evaluating the effect of moose on forest regeneration are examined annually:

1. Browsing pressure in preferred summer habitats of moose is evaluated by determining the percentage of deciduous trees and shrubs (apart from alder) under 2 – 2.5 m with fresh browsing traces on every monitoring area in the last week of August or in September. We adopted this simple method on the recommendation of our Latvian colleague A. Prieditis, who has been using it for estimating the browsing pressure on summer habitats of Cervidae since 1984 (Prieditis 1996).
2. Rumen contents of hunted moose are examined to determine the average content and frequency of occurrence of economically important conifers (see methods in Tõnisson and Mardiste 1996). During the years 1990–2001, 171-1,024 rumen contents were examined annually (4,682 total).
3. The damage done by moose during the previous year is measured in permanent survey plots in 114 middle-aged spruce stands and in 94 young pine plantations. As the survey plots were established in 1998 and 2000 respectively, the collected data are preliminary.

RESULTS AND CONCLUSIONS

Both the counting of winter pellet groups and the counting based on the reports of hunters indicate that the average population density of moose has increased after 1995 and remained at an average of 4-5 moose per 1,000 ha (approximately 10,000 moose in Estonia) during the last 2 years. The variability is great, ranging from 2.0 – 9.6 moose per 1,000 ha in 6 monitoring areas in the spring of 2002.

The browsing pressure on summer habitats varied between 14 – 32.8 % in different monitoring areas during the period 1994 – 2001 (Fig. 2). This indicates a low usage of

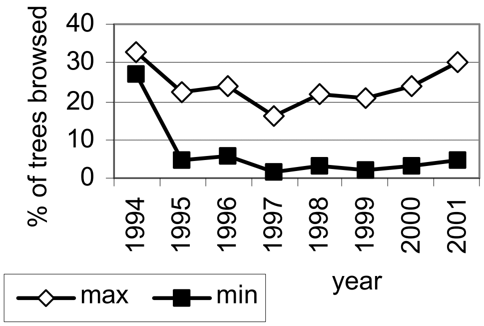

Fig. 2. Variation of browsing pressure in 6 monitoring areas in Estonia during the years 1994 – 2001.

summer habitats. According to A. Prieditis (1996), a critical browsing level is attained if 50% of edible trees and shrubs have been browsed. He has also shown that the browsing pressure varied between 35 – 70% in different forestry districts in Latvia in the 1980s. We suppose that the same occurred in Estonia during this period.

The occurrence of spruce bark in the rumen contents has decreased significantly during the last years compared to the beginning of the 1990s. The content of pine twigs and needles is diminishing as well (Figs. 3 and 4).

It seems generally that the current moose population density does not cause problems for forestry. However, conditions exist for a rapid rise in moose numbers and an increase in forest damage. In a sense, the present situation is similar to the post-war period. First, the intensity of cuttings has multiplied during the last few years (Fig. 1) and the biomass of available browse is growing. Second, in recent years one could again notice a rise in browsing of young pine and peeling of spruce bark, which has also been confirmed by the data from the analysis of the survey plots (Figs. 5 and 6), and last, the number of wolves has declined (Fig. 1). Certainly, unlike the post-war years, nobody favors extermination of the

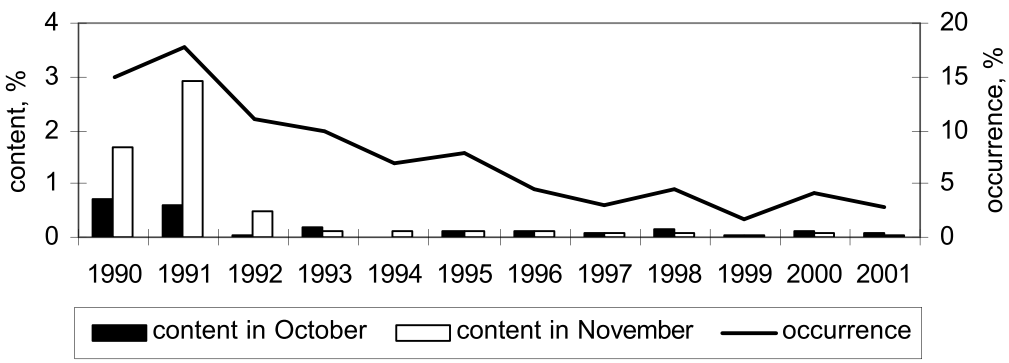

Fig. 3. Spruce (*Picea abies*) in rumen contents of hunted moose.

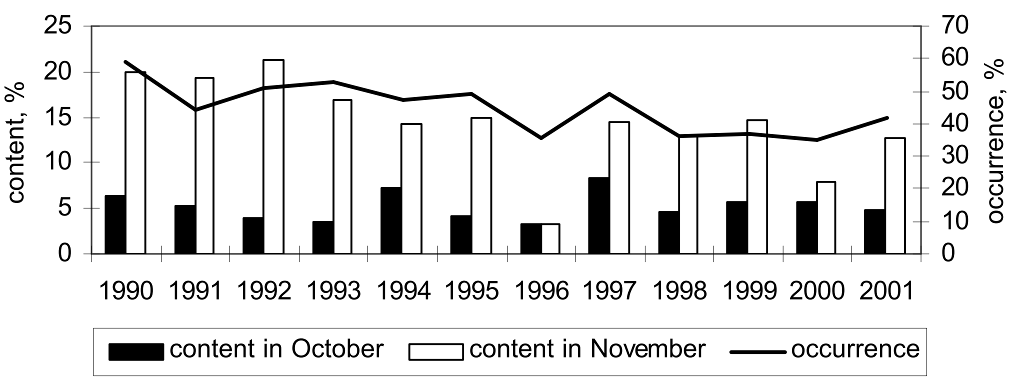

Fig. 4. Pine (*Pinus sylvestris*) in rumen contents of hunted moose.

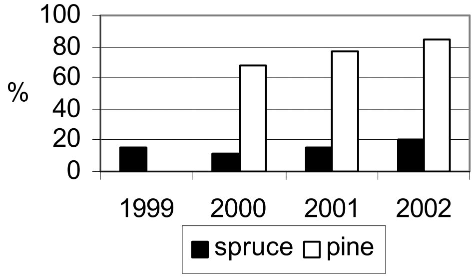

Fig. 5. Percentage of survey plots with freshly damaged trees.

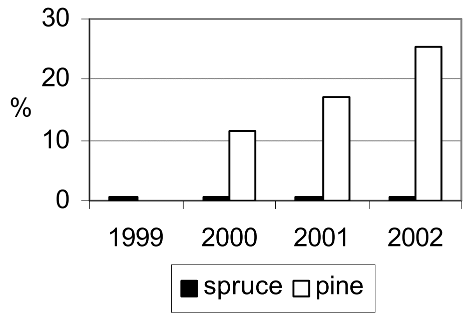

Fig. 6. Percentage of freshly damaged trees on the survey plots.

wolves. Our aim is to maintain a stable population of approximately 150 wolves in our country, although such a small population probably cannot regulate the moose herd. We expect that in the next decade our monitoring system and collaboration with game management authorities will be put to the test. If we can foresee and avoid the next undesirable fluctuation, we will be confident that we are going in the right direction.

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